



School of Business, Society & Engineering

Analytical Finance

Bachelor Thesis in Economics

Spring 2018

Bachelor Thesis in Economics

How Elderly Population Affects Economic Growth

An empirical approach on Nordic countries

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Abstract

The age structure and its impact on economic growth is a current issue that concerns all countries in the world. For Nordic countries, the issue lies within an ageing population and the economic implications of the growing share of elderly. Thus, this paper strives to investigate how the age structure in Nordic countries affects the economic growth, mainly looking at the ageing population. A time series regression analysis conducted with the ratio of working population to total population, the elderly population to the total population, and population growth as explanatory variables to investigate the age structure's effect on the economic growth in the Nordic countries. The regression analysis that has been extended to include variables for age structure. The result shows the aging of the population with its negative consequences for the labor structure, potential economic growth, and fiscal policy should give the necessary urgency to new efforts to implement the relevant reforms. Only the prime working age group has a significantly positive effect on the economy.

Key words: Economic growth, age structure, ageing population, demography, Scandinavian model of economy, Solow's growth model, silver economy.

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1. INTRODUCTION

For the second half of the twentieth century, the worsening of demographic problems, caused by the impact of a new phenomenon for the demographic history - the aging of the population - was a characteristic throughout the world. The main factor, which impact the aging of the population, is a decline in the birth rate, which has become almost ubiquitous in countries that have completed the demographic transition (Izekenova et al., 2015). Over the past decades, the number of elderly people in the EU region has grown, while the number of working people (in relative terms) decreased (The World Bank, 2018c). The proportions of those and others quickly changed not in favor of the economically active population. In subsequent years, the effect of these trends will continue. The proportion of elderly in the age structure of the population against the backdrop of negative indicators of its natural increase will skyrocket.

The purpose of the thesis is to study the aging of the population and its economic consequences in the Nordic countries (Denmark, Finland, Iceland, Norway, and Sweden). The object of work is the demographic aging of the population, and the subject is the impact of population aging on the economic growth in these countries.

For many years this topic has interested demographers, economists, and sociologists. A lot of scientific works have been devoted to the study of social issues concerning the elderly people, their biological features, the study of the conditions and motives for increasing life expectancy. The starting point of these works is to determine the attitude of society towards the socio-economic situation of the elderly population, considered as a serious challenge to the development of society as a whole.

In order to achieve the purpose set, it is necessary to consider the following tasks:

- 1) To study the phenomenon of demographic aging and its causes of emergence;
- 2) To analyze key concepts and methods for estimating the aging of the population
- 3) To study the main trends of population aging in the Nordic countries at the moment;
- 4) To determine the consequences of population aging on the development of the economies of countries;
- 5) To reveal the effect of aging population on economic growth with the help of the econometric model.

The complexity and multidimensionality of the aging of the population as a socio-demographic phenomenon entails a variety of approaches to its study and the identification of its various consequences. Despite a large number of scientific publications on the problems of population aging, it will never be enough to analyze this problem as the transformation processes happen every day and they need to be addressed based on the current discussions. The attention of this paper is given to the features and long-term trends in the aging of the Nordic population in a regional context as those countries belong to progressively-minded and highly developed.

The rate of GDP growth is the ratio of the difference between the volumes of real GDP in the current and previous periods to the volume of real GDP in the previous period. For a more precise definition of the state of the economy, real GDP per capita can be used as an indicator of economic growth. The data were taken within specific period of time, namely 1970-2016.

As a result of the analysis of the obtained data, the following results were found. Scandinavian countries (Sweden, Norway, Iceland, Finland, and Denmark) are the most strongly developed regions from the point of view of economy and demography, however they are affected

by the population aging problem. The strongest impact of population aging on the economic growth was obtained in Iceland. Also, population aging affected the economic development of Finland and Sweden. The aging of the population affects the economy in the following main areas:

- The employment and quality structure of the workforce, including employment of pensioners;
- Pensions and living standards of older people as a significant (in the aging) part of the whole population;
- Health, organization of health care, and social services.

The aging of the workforce affects its productivity in two main areas, namely in connection with the length of service, labor skills, experience, and qualifications are growing. In industries with a stable and traditional professional qualification structure, this plays a positive role. However, in the prospective branches related to the scientific and technical (information) revolution, secondary special and higher education, the ability to adapt quickly to changing technical and technological conditions, is of great importance. These characteristics are mostly enjoyed by young people. They quickly master and use the new achievements of science in production, are more educated, more mobile both professionally and territorially.

As the World Bank informs, the growth of the elderly population, the so-called gray revolution, characteristic of developed countries with a high standard of living and social security of the elderly, has spread to developing countries that do not have the economic means to cope with such a socioeconomic problem as the aging of the population (Dorfman & Palacios, 2012). Since these countries have weak social security for the elderly, they become a burden to these states. The aging population slows down economic development while increasing the cost of social security for pensioners.

2. THEORETICAL BACKGROUND

2.1 Literature Review

The theory in this section will offer an explanatory background for the demographic changes that can be observed in all counties, and its impact on the economic growth. An economic science considers the population as the most important factor of economic and social development and at the same time as an object of such development. This approach is a reflection of reality as the population is the only source of the country's labor resources. The concern for the reproduction of population constitutes one of the main functions of any state. The more complete and reliable the statistics on the number and structure of the country's population is, the more useful the recommendations of economists can be in determining the state policy of employment, investment, redistribution of income, etc.

Given the practical importance of population change and its structure, almost all economic developed countries are attempting to plan demographic processes. The success of planning depends on the accuracy of the diagnosis of the causes of population change, the quality and timeliness of censuses, the use of mathematical methods in modeling the behavior of the population, and the consideration of key factors, namely biological, cultural, social, and economic, affecting its dynamics. However, modeling alone cannot reveal the behavioral factors of such a dynamics, without which, as well as without taking into account the environmental impact, realistic demographic policy cannot be carried out. There is also an inverse relationship: the population is a

key factor in economic and social planning at all its stages and levels, namely international, national, and regional. Nevertheless, the population projections, as a rule, were not confirmed by life.

In this regard, the studies of the causes and consequences of population growth and discussions about them are taking an increasingly global character. An attention to this problem was especially intensified in the second half of the 20th century. This was due to the threat of depletion of natural resources caused by an increase in the rate of economic growth in most countries of the world and an accelerating increase in the world's population. This problem was addressed at the World Population Conferences held in Rome (1954), Bucharest (1974), and Mexico City (1984), during which attempts to identify political means to improve the management of population growth and resources for humanity were made (Weeks, 2015).

In the 1960s and 1970s, the so-called neo-Malthusian fear of the effects of rapid population growth, especially in developing countries, and the growth of personal consumption in industrialized countries was observed (Bloom, Canning & Sevilla, 2001). This alarm was reflected in the reports of the Club of Rome. The forecasts of a rapid increase in the population of developing countries and the threat of famine were especially gloomy. However, in the last decades, the demographic situation has changed. A tendency of the birth rate reduction and, consequently, the slow rate of population growth has appeared (Weeks, 2015).

At present, several regularities in the dynamics of population growth and its structure have been identified and are in effect, which must be taken into account when formulating an economic strategy at the national level.

First, there is a slowdown in the rate of natural population growth as the socio-economic level of the country's development increases (Commission of the European Communities, 2008). Since the level of economic development of the country is determined by a multitude of interrelated factors, the dynamics of population growth is also influenced by not less than their number. Among the main factors affecting this process, one should attribute the reassessment of values due to the growth of the population's incomes, the raising of the cultural level of the population, the improvement of healthcare, and the conscious regulation of the birth of children in the family. In the same direction, there is an increase in the employment of women in public production in economically developed countries, which was promoted by raising the educational level of women, creating new jobs in the sphere of social services, eliminating discrimination in paying their labor, etc. (Commission of the European Communities, 2008). The relevant laws adopted in developed countries and their strict observance became the instruments for the realization of women's rights to work.

Secondly, the greatest decline in the birth rate and natural population growth throughout the world occurred at the expense of developing countries (Nargund, 2009). The main reason for this trend is the widespread desire of countries with the highest birth rate to implement family planning as an integral part of the national socio-economic policy. Governments and the public in these countries have abandoned the macro-social model that denies special demographic control and is based on the assumption that economic and social changes in the country should themselves lead to a change in the population. By the 1990s, the hostility to family planning programs, which prevailed among the leaders of developing countries, had weakened. A birth control began to be considered as part of a policy aimed at improving health care, social security, and education (Bloom, Canning & Sevilla, 2001).

In developing countries, in those years, two models of the impact on family decline were implemented. The instrumental model considers the entire population from the standpoint of its ability to regulate the family and provides for a set of external measures of influence on this process (Morris & Gennetian, 2012). The disobedience model focuses on deviant groups (adolescents, paupers, etc.), in which a variety of methods are used, namely psychological, economic (incentives

and coercion), etc. (Morris & Gennetian, 2012). As a result, the last 15-20 years are estimated by specialists as a historic turning point in the world's demographic development, characterized by a reduction in the rate of population growth in the world. A particularly effective birth control policy was in China and the countries of South America.

Thirdly, there was a reassessment of the significance of the population in the economic development of the country. As follows from the analysis of the economic development of countries with a high natural population growth, the poverty is partly explained by the inadequate use of human and technological resources. However, the population growth is not necessarily an obstacle to development. The productive abilities of people as wealth-creators have been underestimated. The pressure of the population can contribute to the economic growth and social change (European Parliament, 2015). This is evidenced by the experience of the newly industrialized countries, China, etc.

Fourthly, in the economically developed countries, there was a clearly tendency to a drop in the birth rate and natural population growth. For the countries of Western Europe, the fluctuations in the dynamics of population are characteristic since 1920s. The fall in population growth during the Second World War was replaced by the postwar baby boom and from the mid-1950s on by its further increase due to the policy of stimulating the birth rate (Bloom, Canning & Sevilla, 2001). Since the late 1960s, there has been a drop in the birth rate in these countries, a trend towards zero population growth, and in some of them, mortality exceeded the birth rate, i.e. there was an absolute reduction in the population (Germany, Austria, Bulgaria, Hungary, Denmark, etc.) (The World Bank, 2018d).

Fifth, all economic developed countries, and especially the European ones, are experiencing the process of population aging. A population aging is the most characteristic demographic phenomenon of the modern era conditioned by a complex set of factors, including the features of population reproduction, the intensity and direction of population migration, the sanitary and demographic consequences of wars. There are several types of population aging. A social aging is manifested in the context of demographic aging, in the form of changes in socio-age indicators in the population structure. The social aging covers such aspects of the older population as increased morbidity, living conditions, lifestyle, quality of life, intergenerational relationships, etc. The economic aging of population is manifested in a decrease in the proportion of the population at working age, which is the most productive part of the population and, due to the results of labor, keep both the population in the able-bodied and the population older and younger than the able-bodied age (Skibiński, 2017).

A biological aging is the process of gradual deterioration of the functional abilities of the body. Each person has his/her own biological features of the body structure, which, other things being equal, determine the rate of biological aging (Tosato et al., 2007). Finally, the complex aging, within which all the above-mentioned forms of aging occur, is ecological aging. The main cause of population aging is the biological aging, followed by the social aging, which is determined by the increase in the average age of the population due to a decline in the birth rate.

2.2. Demographic Aging of Population

The demographic aging of population is characterized by an increase in the number and proportion of persons of retirement age in the population, accompanied by a decrease in the number and proportion of children and persons of working age in the population (Eggleston & Fuchs, 2012). The demographic aging is one of the manifestations of the transformation of the age structure in the process of demographic transition. In addition, the age and sex structure is the most important characteristic of the population, perhaps even more significant than the total population. This is mainly due to the fact that the structural factor, affecting deep qualitative processes in the

population, can leave its general quantitative characteristics unchanged. The analysis of the age composition of the population makes it possible to penetrate deeper into the essence of individual demographic and socio-economic processes, and, consequently, to understand the features of reproduction in general.

There are two main factors underlying the aging of the population, namely a decrease in mortality (an increase in life expectancy) and a decrease in the birth rate (Eggleston & Fuchs, 2012). The increase in the average life expectancy is one of the greatest achievements of mankind. However, the increase in a life expectancy at birth is not directly related to the aging of the population, since the improvement of this indicator mainly depends on the reduction of infant mortality, and this usually leads, first of all, to an increase in the number of children and infants and, consequently, of older persons. A parallel progress in increasing the life expectancy of an adult contributes to an increase in the proportion of older people. Reducing the birth rate is also an important factor in the aging of the population, since the fewer children are born, the higher the proportion of older people becomes. The higher the rate of decline in the birth rate is, the faster the aging of the population will be.

There are two approaches to assessing the level of aging of the population and, depending on them, the age at which a person is considered to be elderly is 60 years and over (according to the demographic aging scale built by the French demographer J. Bože-Garnier and modified by E. Rosset) or 65 years and older (according to the UN demographic aging scale). In accordance with the first approach, the population is considered old, if the proportion of the population aged 60 and over exceeds 12% (Eggleston & Fuchs, 2012). According to the United Nations demographic aging scale, the population is considered old if people aged 65 and over are 7% (Izekenova et al., 2015). Both approaches are widely used in statistics, but the former is more typical for the post-Soviet countries, where life expectancy is somewhat lower than in developed countries, just like the retirement age, and the second is for the countries of the European Union, the United States, Canada, and other developed countries.

An economic growth is one of the most important phenomena of the economic system of any country, which is in continuous development under the influence of various factors. The economic growth is an increase in the volume of production in the national economy over a certain period of time (usually a year). It is not only a quantitative characteristic but also a qualitative one, that is, economic growth is the growth of real output and / or a change in the quality of goods that are included in the gross domestic product (GDP).

The French economist Jean Baptiste Say, who entered the history of economic thought as the author of the three-factor theory, believed that when creating the value of a product, three factors are equally involved, namely labor, land, and capital (Hunt & Lautzenheiser, 2011). Later, the list of factors of production was enriched by such factor as technology, and several classifications of factors appeared. First of all, there is the classification by the way of influence on economic growth into direct (an increase in the number and quality of labor, an increase in the volume and quality of capital resources, an increase in the quantity and quality of natural resources, an improvement of technologies, and the growth of entrepreneurial abilities and indirect (a decrease in the level of monopolization of markets, a reduction in the prices of production resources, a reduction of income taxes, and increased opportunities for obtaining credit) factors (Hunt & Lautzenheiser, 2011). It is worth noting that by content factors may be divided into economic (an increase in quantity and quality of resources) and non-economic (including cultural, national, geographical, and military-political). By the nature of economic growth, there are intensive (scientific and technological progress and the growth of the quality of human capital) and extensive (the growth of capital expenditures, increased labor costs, and the growth of raw materials) factors.

Since the purpose of research is to study the impact of population aging on economic growth, the more attention should be paid to the production factor, such as labor. Labor, in terms of

demography, is a working share of the economically active population. Many scientists were studying the influence of different characteristics of the working population - the structure, size, and quality of workers - on the development of the country's economy. Most often, economists consider the impact of population growth on economic growth without paying due attention to the age structure of the population.

According to An & Jeon (2006), the transformation of the age structure of the country's population is more important than the population change. For each age group of the population, various features of economic behavior are characteristic and, consequently, it leads to different economic consequences: young people need investments in education, the able-bodied population creates a labor supply and makes some savings, and pensioners should receive quality health care and pensions. When the relative share of any age group changes, the economic influence of this group also changes.

Even favorable changes in the demographic situation that can be achieved through the effective measures of demographic and social policy will not be able to radically change the dynamics of numbers and age structure due to the aging initial age structures. However, on the other hand, for the modern population, it is the structural factor that makes the main contribution to the coefficient of natural increase and prevents the rapid aging of the population, caused by a decrease in the birth rate.

There are a number of patterns of changes in the structural characteristics of the population and the indices of the contribution of the age structure to the reproduction of the population in the process of the demographic transition. Thus, during the transition from high fertility and mortality to low levels, the influence of the structural factor is strengthened, which is manifested in an increase in the contribution of the structural component to the coefficient of natural population growth. The demographic aging of real population is accompanied by a more rapid aging of stable population, which can lead to an increase in instability. The demographic aging of the population is accompanied by a decrease in the potential for demographic growth, i.e. a decrease in the contribution of the original age structure to future population growth, and the Fisher vector component, reflecting the value of age groups in terms of their contribution to the reproduction of the population (An & Jeon, 2006).

2.3 Economic Growth Model

Depending on the factors of economic growth, economic growth models are built. In general, there are two main types of models, namely two-factor and multifactor models. The main goal of constructing such models is to determine the conditions necessary for equilibrium growth, which implies the development of the economy, when the volumes of demand and supply that increase from period to period in macroeconomic markets are always equal to each other with the full use of labor and capital.

Two-factor models of economic growth are actively used in the neo-Keynesian economic theory. The neo-Keynesian models of economic growth were formulated almost simultaneously by the American economist E. Domar and the English economist R. Harrod. The results obtained were so close to each other that they were later called in science as a Harrod-Domar model. E. Domar clarified and supplemented the theory of investment decisions of J. Keynes, proving that investments are not only a factor in the formation of income but also the creation of capacities, and hence the development of production and supply of goods (Masoud, 2014). Thus, he proceeded from a balanced state of the economy, when the national income representing the total demand equals the production capacity, which, in turn, represents a common proposal.

It follows from the Harrod-Domar model that under these technical conditions of production, the rate of economic growth is determined by the magnitude of the marginal propensity to save, and a dynamic equilibrium is inherently unstable, and active and purposeful government actions are required to maintain it in the conditions of full employment. The limited nature of this model was determined not only by the prerequisites for its analysis (the relationship between capital stock growth and output growth is linear) but also historical conditions: it more or less adequately described the real processes of economic growth in the 1930s and in the postwar period, when the main efforts in the development of production focused on increasing investment and creating new production capacity with a constant capital intensity (capital-output) (Masoud, 2014). In the later period, the prospects for the development of production increasingly began to be determined by the impact of qualitative changes on it, which was reflected in the multifactor models of economic growth.

The multifactor model assumes the impact on growth of all factors of economic growth. A general idea of the interaction of all these factors can give a production capacity curve. It shows how a different combination of factors affects the number of options produced. One of the most famous neoclassical models of economic growth is the Robert Solow model, known as the Golden Rule of Accumulation. In 1987, the author was awarded the Nobel Prize in Economics for its development.

According to Acemoglu (2009), the model reveals the mechanism of influence of savings, growth of manpower, and scientific and technical progress on the standard of living of the population and its dynamics. In a stable state of the economy, with a growing population, capital and output per worker remain unchanged. As the number of employees grows at a certain rate, the capital and output must grow at the appropriate rate. Consequently, population growth cannot ensure a sustained rise in the standard of living, since the volume of production per worker in a stable state remains constant. However, the population growth may explain the continued growth in gross output.

The population growth, like retirement, reduces capital-labor ratio, although in a different way - not through a reduction in the available capital stock, but due to its distribution between the increased number of employees. In the course of analyzing patterns and causal links of economic development, it is precisely R. Solow's economic growth model that is most suitable for use at the regional level from all the above-mentioned models. This model is an effective tool for analyzing the impact of a specific economic policy on the state of the economy as a whole, the standard of living of the population, its employment, and prospects for economic development (growth).

The resource potential of the older generation is the qualitative characteristics of the individual, meaningful for it personally and enabling it to interact effectively with other people, to participate in the social and economic life of society. To expand social transactions, an important element is the evaluation of the resource potential of the older generation. In the research carried out by the author, it was shown that a certain proportion of older age cohorts retains the resource potential, which has a multicomponent structure, the main elements of which are good health, a high level of education and the need to continue working, to participate in social processes. Thus, the Solow model shows that countries with higher population growth rates will be characterized by lower capital and lower incomes.

2.4 Scandinavian Model

Unlike most European countries, which have a wide range of universal social security systems, but face political, social, and economic problems, the Scandinavian countries maintain a high dynamic of economic development. This is facilitated by a combination of the unique

conditions of the Scandinavian countries, namely historical traditions, the presence in society of a political compromise on the main issues of the development of countries, a high level of social cohesion and collectivism, and broad trade union rights. An equally important condition for the competitiveness of the economies of the Scandinavian countries is their effective transformation in the new economic conditions. Scandinavian countries usually include the countries of the respective peninsula - Norway, Sweden and Finland, as well as Iceland and Denmark, which are outside of it, but have close economic ties with the above-mentioned countries and an economic model similar to them, often called the Scandinavian one.

The main differences between the Scandinavian model and the model of the states of a number of European Union countries are that Scandinavian countries provide a greater degree of social protection and provision of the population, strengthening of solidarity and increasing equality. The economic policy of the Scandinavian countries is aimed at creating conditions for maintaining a high level of employment, the stability of prices and revenues, environmental protection, economic growth, and assistance to developing countries. For the functioning of the Scandinavian economy and the implementation of social goals, an extensive and universal policy of high quality is used, which provides many services and assistance to the population in complex and unanticipated situations, such as job loss, decree, and many others.

At the present stage of the economy, the Scandinavian countries are among the most striking examples of competitive, innovative, and economically developed ones. They demonstrate outstanding results and occupy leading positions in the ranking of competitive economies of the world. Based on the Scandinavian economies model, it is possible to identify three main components, on which this model is based:

1. A sufficiently high level of development of political culture, conditioned by the presence of a compromise in society on the basic issues of life, the minimization of the corruption component, and freedom of speech;
2. A broad and effective program of social protection of the population;
3. Innovative approach to the development and management of the economy as a whole.

The following reasons for the increase in the welfare of the Scandinavian countries may be distinguished:

1. The harmonization of the relationship between labor and capital. All conflicts are regulated only after careful discussions of the positions of the government, trade unions, and companies.

2. The national planning of human resources. Scandinavian countries are very cautious about the labor market, the effects of squeezing wages in Scandinavia, namely increasing mobility of human capital not only within the country but also outside its borders, can be highlighted. In fact, the model of general welfare can be compared to the universal implicit contract of social insurance.

Like any other insurance market, this model becomes problematic if adverse selection implies that good risks go away from the market, and bad ones, on the contrary, appear. Here, possible problems of emigration and immigration occur. Naturally, the good risks are the Scandinavians, who have become emigrants. The status in the labor market of these migrants becomes determining: whether a person will be financially a net payer (donor) in the labor market or a net beneficiary of public welfare. Immigrants are much less attached to the labor market, so they become pure recipients of the pay and welfare system. As for emigrants, among them there will be a problem of excessive representation of highly skilled workers in the labor market, which will become pure donors. In this regard, it is possible to reduce tax revenues (people who have regularly paid taxes, become emigrants and do not make allocations to the budget), and increased costs.

There is the key dilemma in the direction of labor policy. First, the public sector offers free education in order to ensure equal opportunities and reduce risks in making educational decisions. Education expenses are financed from general taxation. This implies that people who have received

education (at the expense of taxes) will have higher incomes and pay higher taxes, which ensures the function of the capital market and the sharing of risks. In this regard, the Scandinavian model of the economy is very sensitive to the mobility of human capital as the decision to migrate can be taken already after financing the education by the public sector.

At the same time, immigrants in the labor market are not in a position either to replace the highly skilled workers who left the country, nor to compensate for the losses incurred by the state in financing education through taxes. This fact raises the second problem of the labor market, which is the weak integration of immigrants into the market either because of insufficient qualification or because of discrimination.

3. A fair and reasonable system of taxation. Here it should be noted that, unlike the US, tax rates in the Scandinavian countries are 5-7% lower (The World Bank, 2018b). If to compare the Scandinavians with the inhabitants of Greece, then the northern peoples are more responsible and adequate in terms of tax deductions, they regularly pay taxes and do not try to evade them. In Greece, the mentality is fraught with dishonest attitude to the tax charges. At the same time, Scandinavia has quite high taxes on the so-called negative costs, namely alcohol, tobacco, environmental pollution, and traffic violation. Scandinavian countries have very high mobility of factors of production, which imposes some restrictions on the amount of tax collections. The more mobile the tax base is, the more difficult it is to maintain a rate that exceeds the values of the nearest trading partners. Therefore, in order to reduce the loss of tax revenues, it is necessary to introduce lower tax rates, attracting more economic activity

4. A high control by the state. The state support of the government of the Scandinavian countries is carried out at a high level. If to recall the global crisis of 2007-2009, in the Scandinavian countries, for example, Norway, when the economy faced the crisis of insolvency in the 80s, the state nationalized the banks, dismissed the failed bankers, managers, and boards of directors. After the recapitalization, the state brought the banks to a healthy balance sheet, and then profitably sold them on the exchange.

One of the most striking examples of the successful Scandinavian model of the economy is the Kingdom of Sweden. The government of the country influences the economy through various economic instruments. For example, a reform was undertaken, related to the comparability of labor incomes of various categories, the profits of firms, and the levels of efficiency of enterprises. It was decided to equalize salaries for all enterprises and industries to increase economic development through raising wages in low-productivity sectors and reducing it in the most highly productive. So, in Sweden, wages vary depending on the degree of productivity of the firm and industry. On the one hand, enterprises with low levels of labor productivity are being squeezed out of industries in which they could function, paying workers a high salary. On the other hand, workers in industries with high productivity lose the opportunity to capture the difference in productivity, expressed in the form of higher salaries. In response to the declining profits of inefficient firms and the increased profits of high-performing companies, labor and capital will be forced to shift from low-efficiency to more efficient firms, increasing aggregate efficiency and enhancing equity. This is done, for the most part, in order to protect the growth of public spending from increasing wages of agents of the domestic labor market, which lead to serious gaps in income levels.

The peculiarity of the current state of the Scandinavian countries in the global economy is their high GDP growth, with the highest level in Iceland and Sweden. The countries of this group are recognized leaders on such an integrated indicator as the Human Development Index, according to which Norway traditionally retains the first position (United Nations Development Programme, 2015).

2.5 Denmark Economy

The Scandinavian countries are among the small European states in terms of population size, which does not exceed 10 million people. The main factor negatively affecting the economic situation in Denmark at the moment is the continuing low conjuncture in the EU countries - the largest market for Danish products. Nevertheless, OECD experts estimate the state of Denmark's economy as stable and forecast its GDP growth (OECD Economic Outlook, 2017). In 2016, GDP per capita made up \$53,578.76, which is higher by 14 times compared to 1970 (The World Bank, 2018a). The main constraints on the growth of industrial production and exports, as well as the investment attractiveness of Denmark, are traditionally the high level of wages (gross) and taxation.

The high level of taxation is compensated by the relatively reasonable expenditure of funds raised for the development of education, infrastructure, and innovative technologies, which contributes to the growth of labor productivity and the competitiveness of the Danish economy. Unlike other countries in Scandinavia, Denmark has the most flexible labor market, which makes it one of the most effective in the world. The number of the population aged 15-64 years in the country during 1970-2016 increased by 16.2% and by 2016 was 5.7 million people (The World Bank, 2018c).

According to the situation in the labor market, Danish economists have long had a common opinion that fits into several items (Totally Money, 2017):

- Danes work too little (working week - 33 hours);
- They receive too high salary (Denmark has the highest gross salary in the EU with average labor productivity);
- Too many Danes are employed in the public sector, which puts a heavy burden on the state budget.

2.6 Norway Economy

As for the Norwegian economy, it is an example of a mixed economy, where market activity and a large share of state property are combined. The government controls key areas, such as the oil sector, hydroelectric power generation, aluminum production, the largest Norwegian bank and telecommunications services. The government controls 31% of private companies. The country's GDP per capita increased from \$3,306.22 in 1970 to \$70,867.94 in 2016 (The World Bank, 2018a).

The economic situation in Norway in 2016 is characterized as a recession. The two-year drop in oil prices led to a decrease in investment in the oil and gas sector, and consequently the demand for oil and gas companies declined, which affected the industries of mainland Norway and led to a significant decline in business activity in the economy since the autumn of 2014, and a number of other negative effects. At the same time, in connection with the growth of oil prices in 2016, there were signs of a smooth rise in the conjuncture of the national economy.

The growth of unemployment and the depreciation of the national currency since 2014 led to a decrease in the attractiveness of the Norwegian labor market and a reduction in net immigration from 40,000 in 2014 to 26,000 in 2016 (Thorud, 2018). In turn, a decrease in immigrant flows eased further unemployment growth in a recession economy. A weak Norwegian krone with a simultaneous decrease in wage growth contributed to a significant increase in the competitiveness of export-oriented industries.

To date, the network of state employment centers maximally helps citizens of their country with employment. At the same time, many companies finance training for hiring employees and

also send those already working for advanced training in accordance with innovative technologies. The amount of population aged 65+ by 2016 increased to 16.59% from 12.85% in 1970 (The World Bank, 2018c). However, the state has one of the lowest unemployment rates in Europe, and is among the five most well-off countries in terms of employment (Trading economics, 2018). Since 2009, Norway has held the first place in the world, and in 2016, dropped to the second place in the index of prosperity, which includes such factors as wages, the quality of medicine and education, the conditions for doing business, the level of safety, ecology, the level of corruption, personal freedom, etc. (Stende, 2017). Thus, the Norway's place and role in the world economy are determined, basically, by two objective factors. First, it is a narrowness of the Norwegian domestic market and limited production capacity (except for a few branches of the economy), and secondly - large reserves of hydrocarbons and hydropower resources, which make the country an important element of the all-European energy market.

2.7 Sweden Economy

Sweden is one of the most developed countries in the world. The share of Sweden's population in the total world population is only 0.14%, while the Sweden's share in the world GDP is 0.73% (Central Intelligence Agency, 2018b). The country's GDP per capita increased by 11 times from \$4,669.44 to \$51,844.76 (The World Bank, 2018a). Also, Sweden is one of the world's largest exporters of capital (Central Intelligence Agency, 2018b). In the past 15 years, the country has experienced a rapid growth in export-oriented production, the idol of exports to the GDP of Sweden is now about 45%. Given neutrality throughout the 20th century, Sweden has achieved an enviable living standard of the population, has a mixed economy system based on high technology and extensive social security benefits. In the Swedish economy, there are a modern distribution system, excellent internal and external communications, and a skilled workforce.

The main driver of growth in 2016 were the buildup of domestic demand and the growth of international markets. According to the experts of Riksbank, the influx of refugees led to an increased domestic demand in Sweden (Williams, 2015). At the same time, in its forecasts, Riksbank notes the effect of a number of uncertainty factors, including political risks of foreign markets, currency fluctuations, etc. (Williams, 2015). Despite the fact that Sweden produces a huge assortment of up-to-date high-tech and competitive goods and services, the country does not all produce itself and buys much, effectively using the international division of labor. These are mainly raw materials, partially processed raw materials, and semi-finished products, components for Swedish export-oriented enterprises.

2.8 Iceland Economy

The Scandinavian type of social and market economy of Iceland allowed the country to be one of the most economically developed countries in the world. Unlike the euro area countries (both key and peripheral), suffering from excessive external debts, Iceland repaid its obligations, returning to safe levels in 2006. Today, the country, which survived the largest financial collapse in 2008, is again ready to grow and diversify the economy from fishing, tourism, and the aluminum industry in favor of renewable energy sources and information technologies. Its GDP, being one of the highest per capita in Europe and the world with \$60,529.93 in 2016 (Central Intelligence Agency, 2017; The World Bank, 2018a), has returned to pre-crisis levels.

Challenging the austerity measures that prevailed in Europe, Iceland allowed fiscal policy to shoulder the task of combating economic and social tensions. In particular, state money was used to help households pay debts preserving consumer spending helped rebuild. The probability of a

currency crisis is reduced due to the current account surplus (more money is being received to the country than is being withdrawn) and the interest of foreign investors towards Iceland (Central Intelligence Agency, 2018a). They are impressed by high interest rates, growth prospects, and investment opportunities. The local population and companies can fully cope with the high cost of borrowing, since most of the debts are paid, and incomes are growing rapidly. The quantity of elderly population grew almost twice within 1970-2016 (The World Bank, 2018c).

2.9 Finland Economy

Concerning Finland, the country belongs to highly developed small industrialized countries. The international studies of recent years show that Finland is one of the most developed and competitive countries in the world (Stende, 2017). Its advantages are political stability, highly developed infrastructure, accessibility and reliability of telecommunications, freedom of bank competition, a well-established system of cooperation between enterprises and universities, including the development of new technologies, a high educational level of the workforce and management apparatus, as well as an ease of entrepreneurial activity.

Finland is among the leading group of countries in the world in terms of GDP per capita - according to data for 2016, GDP per capita (in current prices) reached \$43,433.03 (The World Bank, 2018a). The decline in the unemployment rate was mainly ensured by the success of the development of the construction industry. At the same time, there is the growth of hidden unemployment, namely those who stopped looking for work, as well as students in retraining courses or on parental leave. The aim of industrial policy in Finland is to achieve sustainable economic growth. The economic growth helps to maintain a high level of employment and promotes job creation. The main factors contributing to the productivity improvement include healthy competition, national competitiveness, structural changes that increase productivity, and the use of global business opportunities. In 2016, the elderly population reached almost 21% of the total population of the country (The World Bank, 2018c).

Despite the fact that the active innovation activity was characteristic of the Finnish economy for many years of its development, it can be argued that precisely from the late 1980s, innovations have become the main driving force of the country's economic growth and the basis for moving to foreign markets. If earlier the innovation process could not be separated from the production one, now in the country, there is an independent science intensive innovative sector of the economy, which is basic for Finland and is export oriented. Thus, the modern type of economy in Finland can be called a knowledge-based economy.

2.10 Consequences of Population Aging

The level of education contributes positively to an increasing work activity among the elderly population and is one of the most important factors affecting their employment, especially the employment of pensioners. On the one hand, the education expands the range of jobs that can be offered to retirees, creates an employer's interest in retaining and using a skilled worker. On the other hand, education, especially higher education, increasing the competitiveness of an employee in the labor market, simultaneously promotes the occupation of activities that require creativity, that is, leads to the fact that work becomes one of the mandatory components of a way of life.

Nevertheless, from the point of view of the experience and the level of development of the world community, the aging of the population does not pose insurmountable tasks for a mankind. Since the aging of the population is evolutionary, its consequences are gradually and predictably manifested. They can and should be timely taken into account. Considering the multidimensionality of the problem of population aging, the necessity of an integration approach to its consideration and

solution arose (Dorfman & Palacios, 2012). In developed countries, this approach is implemented within the framework of the concept of the formation and development of the silver economy. So, in the conditions of population aging, it is customary to call the economy, which maximally mobilizes resources, meets the needs and rationalizes the way of life of the elderly, taking into account social interests and needs. The European government body called the silver economy one of the new waves of growth, noting that, contrary to popular belief, the aging of the population represents a huge untapped opportunity for economic growth in the developed countries of the world (European Parliament, 2015).

As the experience of Western Europe and North America shows, the development of the silver economy is characterized by the following main processes (European Commission, 2015):

- An increase in the duration of retirees' work by continuing their education in the pre-retirement and post-pensions periods, optimizing their employment based on the use of experience and motivation to work;
- Raising the living standards of pensioners, including through employment;
- The growth of consumer demand on the part of older people in such spheres as leisure and culture, tourism, banking services (in older people people are more inclined to accumulate money), pharmacology, medicine, etc. The increase in demand means that producers of these goods and services can increase production and get direct benefits, just like the state, which will receive benefits in the form of tax revenues to the budget;
- The development of gerontological technologies and gerontological marketing, etc.

The concern of the countries is not unfair - the shortage of labor resources threatens to undermine the well-being of the population of these countries by virtue, on the one hand, of reducing the number of workers, and therefore of the taxpayers, and the growth of the demographic burden on the employed population, on the other. Given the fact that older people have the right to vote, and younger age groups in most countries acquire it only at the age of 18-21, an increase in the demographic burden can lead to the redistribution of social expenditures in favor of the former, which, in turn, can provoke an aggravation of intergenerational relations. Finally, another important reason for countries' anxiety in connection with the emerging demographic situation is the growing competition for resources, including human resources, on the part of developing countries. Moreover, if at the present time a significant number of countries in the developing world are at the stage of a demographic dividend, the first signs of population aging have already appeared in the most developed and populated ones (South Korea, China, Brazil, Argentina, Malaysia, etc.). This means that competition in the global labor market will only increase.

Developed industrial countries are making serious efforts to mitigate and / or neutralize the negative social and economic consequences of population aging, using mainly such instruments as attracting foreign labor, reforming the social security system and, especially, the pension system, the integration of developing countries in economic associations of industrially developed countries (for example, the association of developing countries - former colonies of European states with the EU), offshoring. In addition, in response to increasing competition, the corporations from developed countries carry out labor-consuming and material-intensive works to developing countries and / or include them in their transnational production networks of added value. At the same time, one cannot ignore the fact that the changes in the demographic situation and, as a consequence, in the demand structure, give rise to incentives to increase the production of goods and services oriented to meeting the needs of the elderly.

Thus, the aging of the population generates a number of significant social and economic problems, so this phenomenon should be given enough attention. To clarify the situation with the effect of demographic changes on economic growth and to identify what is the link between population aging and economic growth, a regression analysis will be conducted.

3. REGRESSION ANALYSIS

3.1 Data and Method

For the paper completion, the data on the Nordic countries of the share of elderly population, population growth, the part of working population, and economic growth were discussed. The inability to quickly ensure the economic growth of these countries provokes high migration rates, especially among young people, a decline in the birth rate, and rapid aging. The data were taken within specific period of time, namely 1970-2016. The regression equations are significant, since the coefficients of determination are within limits of 0.94-0.97.

The problem statement is investigated with help of a regression model. The dependent variable in the regression model is Gross Domestic Product per capita growth. Independent variables are the ratio of working population to the total population, the ratio of elderly population to the total population, and the population growth in the linear regression model. The data for these variables are gathered annually from 1970-2016 for Nordic countries, namely Denmark, Finland, Iceland, Norway, and Sweden. Data are taken from the World Bank's.

The main prerequisite for the regression analysis is that only the resultant attribute (y) obeys the normal distribution law, and the factor attributes (x_1, x_2, \dots, x_k) can have an arbitrary distribution law. In the analysis of dynamic series, the time is the factor. The regression analysis presupposes the presence of causal links between the productive (y) and factor (x_1, x_2, \dots, x_k) signs. The formula is the following:

$$y = b_0 + b_1x_1 + \dots + b_mx_m + e$$

The regression analysis will allow assessing the effects of population aging on the GDP per capita of Nordic countries. Regression equations for Nordic countries are as follow.

The equation for Denmark is: $y = -108.001 + 0.056x_1 + 9.721x_2 + 0.504x_3 - 0.283x_4$.

The equation for Finland is: $y = -92.562 + 0.04x_1 + 30.826x_2 + 17.376x_3 + 0.101x_4$.

The equation for Iceland is: $y = 26.67 - 0.02x_1 + 32.159x_2 + 27.806x_3 + 0.201x_4$.

The equation for Norway is: $y = -100.805 + 0.047x_1 + 27.716x_2 + 1.296x_3 - 0.27x_4$.

The equation for Sweden is: $y = -65.314 + 0.034x_1 + 7.563x_2 + 19.298x_3 - 0.114x_4$.

In this work, x1 is the time, during which the analysis will be conducted, x2 is the relation of the working population to the total population, x3 is the proportion of people aged 65 and over (elderly population) to the total population, and x4 is the population growth measured in the percentage. The number of collected independent variables is four for every of Nordic countries and one dependent for each country - the natural logarithm of GDP per capita. In order to use the linear regression model, some assumptions about the distribution and properties of variables are necessary, primarily linearity. An increase or decrease of the vector of independent variables by a factor of k leads to a change in the dependent variable by a factor of k as well. The nonlinearity of the regression can be overcome by the transformation of variables, for example, through the function of the natural logarithm (ln). It is expected that the elderly population growth negatively affects the GDP per capita of every country, so the dependence is projected to be inverse. The results of the regression model and Durbin-Watson values for different countries can be seen in next section.

3.2 Results and Estimations

For the analysis of the effect of demographic changes on economic growth and understanding of the relation between population aging and economic growth, a regression analysis is conducted. In the study, the data of the five Nordic countries of Europe during the period from 1970 to 2016 are used. The data was collected with the help of The World Bank. For practical implementation, a software application XLMiner Analysis ToolPak was used.

The total number of observations is 47. In this research, the value of the coefficient of determination R is within 0.94-0.97. For acceptable models, it is assumed that the coefficient of determination should be at least not less than 50%. Models with a coefficient of determination above 80% can be considered quite good. This model indicates that there is a close relationship between the aging of population and the GDP per capita growth. This means that the constructed regression model describes 94-97% of cases when an increase in the elderly population entails an increase in the the amount of GDP per capita. This must be taken into account when applying the results of the analysis in forecasting GDP per capita. In the last column of the table ANOVA, the value of the indicator of statistical significance should be less than or equal to 0.5.

In this case, this indicator is zero. This means that the regression model, constructed on the basis of the data, is valid for the entire population as a whole.

Regression Statistics						
Multiple R	0,9774769949					
R Square	0,9554612755					
Adjusted R Square	0,9512194923					
Standard Error	0,1807025557					
Observations	47					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	4	29,42071312	7,355178279	225,2499037	0	
Residual	42	1,371443373	0,03265341365			
Total	46	30,79215649				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-108,0010435	7,542475672	-14,31904433	0	-123,2223755	-92,77971155
Time	0,05603263153	0,004323525777	12,95993928	0	0,04730740337	0,06475785969
Working population/Total population	9,721132204	2,601777046	3,736343289	0,000557244922	4,470533616	14,97173079
Elderly population/Total population	0,5040015576	3,573270499	0,1410476922	0,8885066273	-6,70715017	7,715153285
Population growth,%	-0,2831634569	0,1511675784	-1,873175849	0,06801460961	-0,5882319772	0,02190506346

Figure 1. The Regression Model of Ageing Population Effect on the GDP Per Capita of Denmark

Regression Statistics						
Multiple R	0,9795722552					
R Square	0,9595618032					
Adjusted R Square	0,9557105463					
Standard Error	0,1782872115					
Observations	47					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	4	31,67895489	7,919738722	249,1554946	0	
Residual	42	1,335025851	0,0317863298			
Total	46	33,01398074				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-92,56246222	21,351409	-4,335192221	0,000089116985	-135,6513495	-49,47357489
Time	0,03979884931	0,01199188594	3,318814865	0,001874888339	0,01559824401	0,06399945462
Working population/Total population	30,82562037	4,568024865	6,748128849	0,000000033353	21,60697309	40,04426766
Elderly population/Total population	17,37571162	6,638569391	2,617387963	0,01226582158	3,978536354	30,77288688
Population growth,%	0,1014327718	0,1793148084	0,5656686847	0,5746288407	-0,2604391578	0,4633047015

Figure 2. The Regression Model of Ageing Population Effect on the GDP Per Capita of Finland

Regression Statistics						
Multiple R	0,9836477802					
R Square	0,9675629556					
Adjusted R Square	0,9644737132					
Standard Error	0,153504597					
Observations	47					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	4	29,5209289	7,380232226	313,2039682	0	
Residual	42	0,9896737749	0,02356366131			
Total	46	30,51060268				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	26,66969252	21,44503866	1,243629957	0,2205326993	-16,60814711	69,94753214
Time	-0,0203453189	0,01200296417	-1,695024552	0,09747378944	-0,0445682810	0,00387764311
Working population/Total population	32,15862179	3,31449067	9,702432436	0	25,46970889	38,84753468
Elderly population/Total population	27,80605112	9,340961342	2,976786875	0,00481797576	8,955228172	46,65687407
Population growth,%	0,2010839126	0,04742819465	4,239754729	0,00012008018	0,1053699419	0,2967978833

Figure 3. The Regression Model of Ageing Population Effect on the GDP Per Capita of Iceland

Regression Statistics						
Multiple R	0,9818373561					
R Square	0,9640045938					
Adjusted R Squ	0,9605764599					
Standard Error	0,1873997212					
Observations	47					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	4	39,50201012	9,87550253	281,2038898	0	
Residual	42	1,474983531	0,0351186555			
Total	46	40,97699365				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-100,8052503	10,47092656	-9,627156657	0	-121,9364354	-79,67406527
Time	0,0467301336	0,0073330021	6,372578734	0,0000001155	0,0319315363	0,0615287309
Working popul	27,7164056	8,331901082	3,326540406	0,0018343241	10,90194868	44,53086253
Elderly populat	1,296056325	4,83077255	0,2682917301	0,789788162	-8,452837253	11,0449499
Population gro	-0,269764062	0,1710414177	-1,577185606	0,1222560552	-0,6149396133	0,07541148937

Figure 4. The Regression Model of Ageing Population Effect on the GDP Per Capita of Norway

Regression Statistics						
Multiple R	0,9694566126					
R Square	0,9398461238					
Adjusted R Square	0,9341171832					
Standard Error	0,1812621398					
Observations	47					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	4	21,56039099	5,390097747	164,0523424	0	
Residual	42	1,37995046	0,0328559633			
Total	46	22,94034145				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-65,31445957	7,74184515	-8,436549466	0,0000000001	-80,93813543	-49,69078371
Time	0,0337470707	0,004856278951	6,949162319	0,0000000171	0,0239467031	0,04354743827
Working population/Total population	7,563316264	5,351848617	1,413215658	0,164961081	-3,237151379	18,36378391
Elderly population/Total population	19,29769081	4,927011788	3,916712936	0,0003241221	9,354578586	29,24080303
Population growth,%	-0,113656665	0,09985608509	-1,138204696	0,2614862043	-0,315174400	0,08786107086

Figure 5. The Regression Model of Ageing Population Effect on the GDP Per Capita of Sweden

Assuming that the null hypothesis is correct, we can calculate how great is the probability of obtaining a t-test equal to or greater than the actual value that we calculated from the available sample data. If this probability is less than the previously accepted level of significance (for example, $P < 0.05$), we have the right to reject the tested null hypothesis. For the available sample data, the t-test is mostly negative for certain degrees of freedom (df). The probability of obtaining such a (or greater) value of t under the condition that the null hypothesis to be tested is correct was different: the p-value for different countries differs significantly for various regression models. Therefore, for values less than 5%, we can reject the tested null hypothesis about the positive impact of population aging on GDP and adopt an alternative hypothesis of the negative one that is discussed. By doing this, we run the risk of making a mistake with a probability of less than 5%.

Durbin-Watson values:**Durbin-Watson for Denmark:** 0.114066**Durbin-Watson for Finland:** 0.343704**Durbin-Watson for Iceland:** 0.642403**Durbin-Watson for Norway:** 0.219586**Durbin-Watson for Sweden:** 0.238049

Since we are interested in the impact of population aging on economic growth, let's look at the variable of the proportion of people aged 65 and over to total population. According to the results of the model, it can be concluded that with an increase in the proportion of elderly in the total population, the GDP per capita is reduced, that is, population aging negatively affects economic growth. There is a positive autocorrelation. The Durbin-Watson criterion is a method for detecting first-order autocorrelation using Durbin-Watson statistics. The Durbin-Watson criterion only reveals a pronounced autocorrelation of the first order and only in the absence of lag variables in the regression. Graphically positive autocorrelation is expressed in the alternation of zones, in which the observed values are higher than those explained by the regression, and the zones in which the observed values are lower. Fougère & Mérette (1999) defined that the macroeconomic impacts of population ageing are greatly modified in case an endogenous growth is included in the models. The findings inform that population ageing could raise motivations for the next generations to spend more in human resources and therefore raise an economic growth.

According to Dougherty (2011), among the main reasons that cause the appearance of autocorrelation, the errors in the specification, the inertia in changing economic indicators, the effect of a web, and data smoothing can be distinguished. The failure of an important explanatory variable in the model or the incorrect choice of the form of the dependence usually leads to the systemic deviations of the observation points from the regression line, which can cause autocorrelation. Many economic indicators (for example, inflation, unemployment, GNP, etc.) have a certain cyclicity associated with the undulation of business activity. Indeed, the economic recovery leads to an increased employment, a reduction in inflation, an increase in GNP, etc. This growth continues until the change in the market's conjuncture and a number of economic characteristics will not lead to a slowdown in growth, then stop and reverse the indicators in question. In any case, this transformation is not instantaneous, but has a certain inertia.

The effect of the web suggests that in many production and other spheres, economic indicators react to changes in economic conditions with a lag (time lag). Finally, often data for some long time period are obtained by averaging the data on its subintervals. This can lead to a certain smoothing of the fluctuations that existed within the period under consideration, which, in turn, can cause autocorrelation.

Figures 6a-e shows a relation between GDP per capita and the proportion of people aged 65 and older to total population in every country. These diagrams indicate that each subsequent value of the residues depends on the preceding ones. In this case, there is an autocorrelation of the residues. The model does not take into account several minor factors, the joint effect of which on the result is significant due to the coincidence of trends in their changes or phases of cyclical fluctuations. As Dr. Stephan Ween and Prof. Uschi Backes-Gellner of the University of Zurich (2008) found out a productivity is most sensitive to age in sectors where blue collars are employed (for example, in construction), while in the banking sector, it does not depend on the age of employees. On the contrary, the productivity of lawyers, scientists, managers, and doctors, only increases with age. Therefore, the impact of aging labor on the economy depends also on the structure of the economy itself. The higher the proportion of physical labor is, the more difficult it is to fight the influence of aging.

The consequences of population aging are characterized by their versatility and ambiguity. With the reference to the economic and social consequences of demographic aging, the well-known action-reaction principle works, which in this case is expressed in leveling the negative aspects of a particular phenomenon (for example, increasing the average age of the employed population) by positive changes within its framework (increase in the proportion of workers, who have extensive experience).

The consequences of autocorrelation of the residuals of the regression model are similar to those of heteroscedasticity:

1) The estimates of the parameters of the regression model remain unbiased and consistent, but efficiency is lost.

2) The dispersion estimates are biased. In this case, as a rule, estimating the variance of the regression underestimates the true value.

3) There is a possibility of incorrect calculation of estimates of standard errors in the coefficients of the model, which may lead to the adoption of an incorrect hypothesis about the importance of regression coefficients and the significance of the model as a whole. This worsens the predictive quality of the model.

The best, but not always possible, way to eliminate autocorrelation is to establish the factor responsible for it and to include the corresponding explanatory variable in the regression. Another method for eliminating this effect is using logarithms and finding differences. The initial values of the variables are logarithmic, and the differences of the logarithmic values are used. For this purpose, the natural logarithm of GDP per capita for every country was used.

The coming demographic changes will inevitably have numerous social and economic consequences for Nordic countries:

- The shift in the structure of demand due to the changes in the age structure of the population. This will affect the demand for market goods and services, but - more importantly - the demand for services provided by the state. As the age increases, the need for health care services increases, and the elderly often require additional social care. At the same time, a decrease in the birth rate leads to a decrease in the number of students in a secondary school.
- The change in the volume and structure of savings. Since the periods of formation and the use of savings alternate, shifts in the age structure of the population significantly affect their dynamics. At the same time, it was noted that the reduction in the share of junior groups reduces the workload for the working population, and the increase in the number of senior groups creates an additional burden on public finances, increasing the need for transfers from the budget (Maestas, Mullen, & Powell, 2016). As a consequence, the demand for financial assets and their value, as well as market interest rates, change.
- The decrease in the supply of labor due to the aging population. Accordingly, with other things being equal, population aging slows the growth of the standard of living.
- A significant increase in the need for budgetary resources due to the growing proportion of the elderly population.

Thus, after carrying out this study, it was found that the aging of the population influences economic growth cyclically, contrary to the popular opinion of economists and demographers about the existence of a linear link. The result of the model is the curve showing the relationship between the growth rate of GDP per capita (economic growth) and the proportion of people aged 65 years and over (population aging) also considering the population growth and the share of working population to the total population.

4. SUMMARY AND CONCLUSION

Population aging is a global trend of the last several decades, connected with serious changes in the demographic dynamics. These demographic changes are determined by two distinct processes, namely an increase in life expectancy and a decrease in the birth rate. According to the UN forecasts, this trend will continue until 2050, therefore, this topic deserves special attention. Aging of the population is a process that has an impact both on the economic side of society and the social side. If to consider the economic sphere, the aging of the population is reflected in the labor market, investment, savings and consumption, pensions, taxation and economic growth. In the social sphere, this affects the living conditions, the increased need for quality medical care and so on. Therefore, the social security, health, and labor systems need reorganization.

The aging of the population increases the demographic burden on the working population, on the system of medical and social services for the elderly, and so on. The fluctuations in the level of fertility after a certain time are manifested in the corresponding fluctuations of competitions between applicants for admission to educational institutions, the level and structure of employment in the labor market, the level of crime, etc. It is known that the general trend of reproduction of the population of developed countries is its aging. However, it should be borne in mind that the material and other benefits that the able-bodied generation has and increases are to a certain extent the result of the work of their predecessors, current pensioners.

The task of multiple linear regression is to construct a linear model of the relationship between a set of continuous predictors and a continuous dependent variable. The Beta coefficients are the coefficients that the author gets if all the variables are brought to the mean 0 and the standard deviation 1. Hence the value of these coefficients allows comparing the relative contribution of each independent variable to the dependent variable.

For Denmark, an economic interpretation of the model parameters is as follows: an increase of x_2 (the ratio of working population to the total population) by 1 unit of measure leads to an increase in Y by an average of 9.721 units; an increase of x_3 (the ratio of elderly population to the total population) by 1 unit leads to an increase in Y by an average of 0.504 units, and an increase x_4 (population growth) by 1% leads to a decrease in Y by an average of 0.283 units. From the maximum coefficient $b_2 = 9.721$, it can be concluded that the greatest influence on the result of GDP per capita growth is provided by the ratio of working population to the total population. It is also established that the parameters of the model are statistically significant.

For Finland, an economic interpretation of the model parameters is as follows: an increase of x_2 (the ratio of working population to the total population) by 1 unit of measure leads to an increase in Y (GDP per capita growth) by an average of 30.826 units; an increase of x_3 (the ratio of elderly population to the total population) by 1 unit leads to an increase in Y by an average of 17.376 units, and an increase x_4 (population growth) by 1% leads to an increase in Y by an average of 0.101 units. Here, the ratio of working population to the total population also has the greatest effect on the result of GDP per capita growth. It is also established that the parameters of the model are statistically significant.

For Iceland, there is also a strong effect of the ratio of working population to the total population and with the time, the GDP per capita raised. For Norway and Sweden, there is an inverse relationship between the population growth and growth of GDP per capita by 0.27 and 0.114 units correspondingly. However, for Sweden, the ratio of elderly population to the total population of 19.298 has the greatest effect on the result of GDP per capita growth. Also, the larger R^2 , that is, the greater the compliance provided by the regression equation, the greater the correlation coefficient for the actual and predicted values of y, and vice versa. For all analyzed countries, the coefficient of determination is close to 1, meaning the models are built on the important factors.

Thus, the ratio of the three main factors of population aging (mortality, fertility, and migration flows) imposes a certain imprint on the development of this process in individual regions of the world. In some, the aging of the population began long ago and came about systematically (France, Germany, Sweden), in others - more rapidly and intensely (China, Latin America), in the third - has not yet begun (sub-Saharan Africa). Despite this, it is necessary to realize that the transformation of the age structure of the population is one of the key factors of social change. The aging of the population - with its negative consequences for the labor structure, potential economic growth, and fiscal policy - should give the necessary urgency to new efforts to implement the relevant reforms. The reforms should not be limited to changing the retirement age and revising the formula for calculating pension savings. The changes should concern the health system, the labor market and other aspects of public life, which may be affected in the long term by the consequences of population aging. In the countries of Europe that achieved the greatest success in this direction, the implementation of reform programs required awareness of threats in a difficult economic situation. However, the need to improve preventive measures for the adaptation of all spheres of public life to the new structure of the population remains.

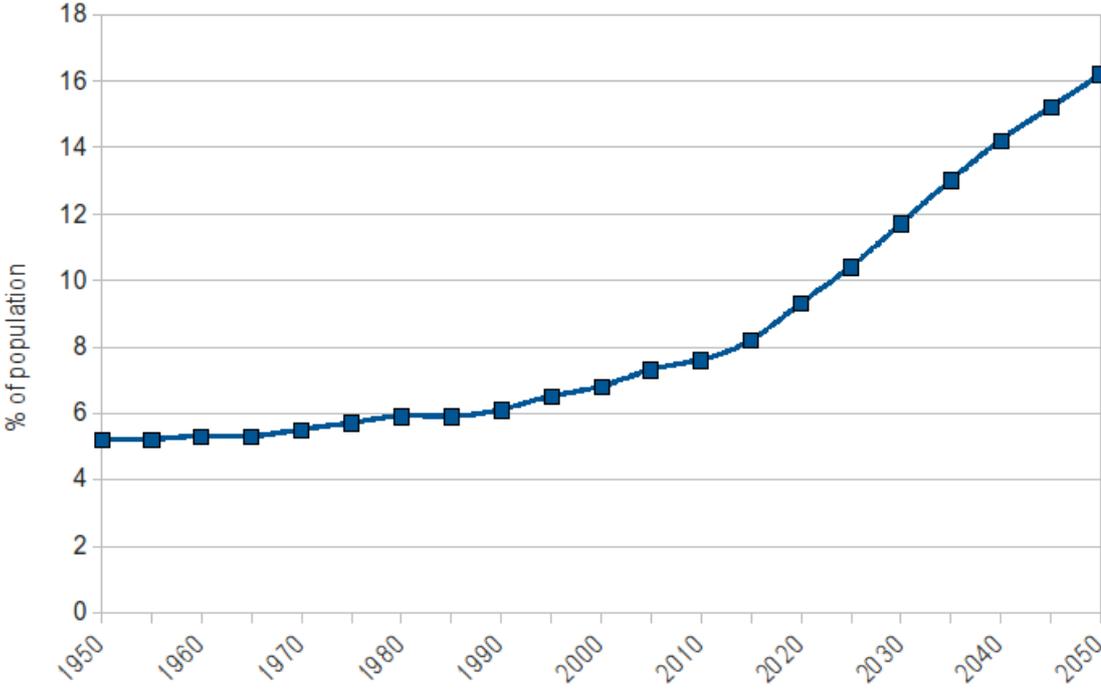
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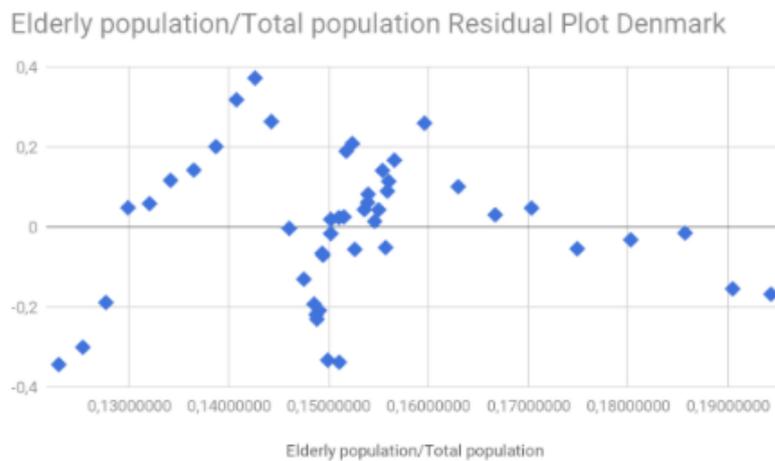
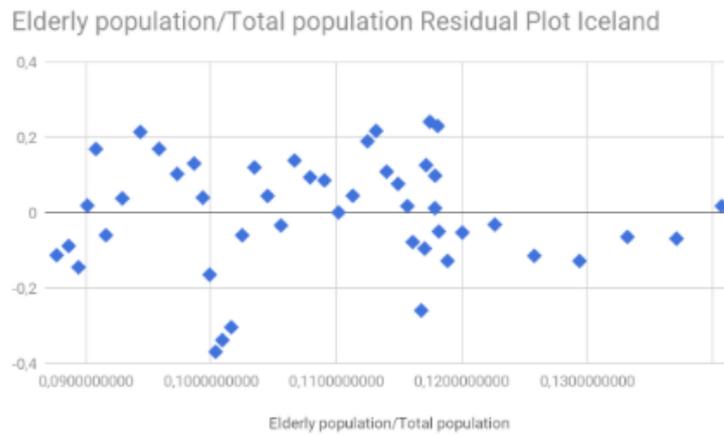
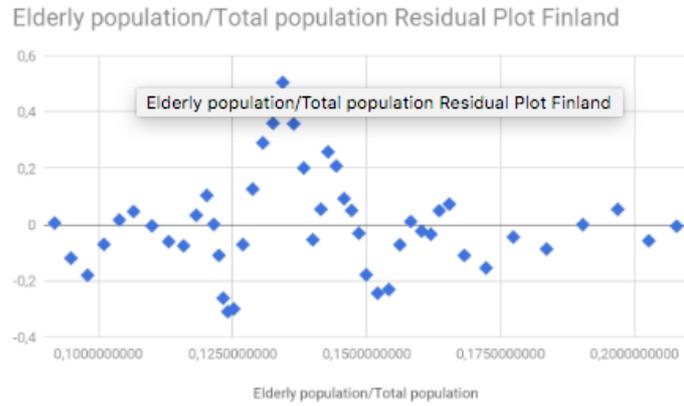
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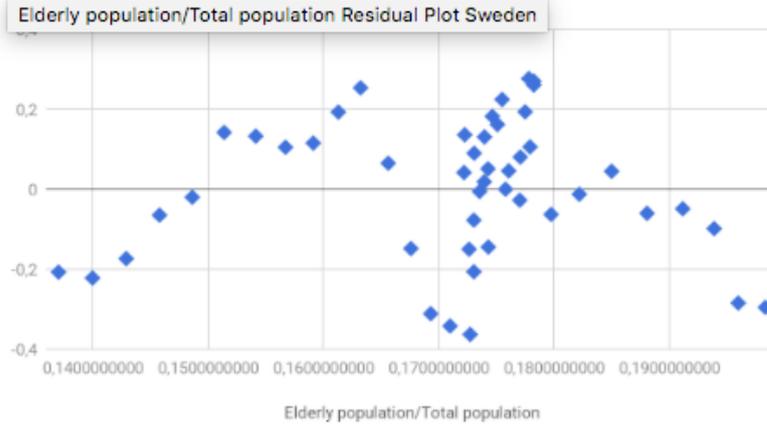
Percentage of the World Population Over 65, 1950-2050
Source: UN World Population Prospect, 2008



Residual Plots of the Elderly Population in Nordic Countries



Elderly population/Total population Residual Plot Sweden



Elderly population/Total population Residual Plot Norway

