DEMOGRAPHIC AGEING OF EUROPE AND ITS IMPACT ON THE BIRTH RATE

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Abstract

The paper analyzes the demographic ageing in the European Union countries in the past half century. Two panel regression models were used to determine the impact of the death rate, percentage of young population, percentage of the old population, and the GDP per capita on the birth rate. In the early period (1960-1990), all demographic factors and the economic factor GDP per capita had statistically significant influence on the birth rate. In the latter period (1991-2015), it is only the demographic factors that have significant influence on natality.

The research also offers descriptive analysis for each EU country individually and classifies the countries in four groups (starting from countries with the least favorable demographic situation to countries with positive demographic trends).

In general, this paper gives an insight on the demographic ageing of the population in EU countries, explains the reasons behind and the consequences resulting from this situation, and suggests some possible solutions.

JEL Classification: J1, J11, J13, C23

Keywords: birth rate, death rate, demographic trends, EU countries, panel regression

Introduction

The most important and somewhat "underestimated" problem that Europe is facing today is its ageing population. It is no news to say that the countries of the old continent are suffering from the same problem, regardless of whether is it a group of countries from the Western, Northern or Southern Europe. It is a "vicious" circle where the young population is becoming a scarce resource. Developed Western countries are lacking both qualified and low qualified working force. They all have highly developed and competitive economies, yet the population is not procreating sufficiently, due to their changed norms and cultural attitudes towards marriage and children. Thus, Western Europe countries open up to "importing" qualified and young workforce from the less developed countries from the Balkans and the Mediterranean, leaving these less developed economies deprived of doctors, scientists, engineers, and other highly qualified professions. Offering significantly higher income than their native countries, Western Europe is very attractive to many young and educated people. Also, political instability, unemployment, corruption, and low income in their home countries only contribute to their making the decision to leave easier.

This paper examines the main demographic trends, such as death rate, changes in young and old population, and their impact on the birth rate in the countries of the European Union. Following the introduction, the second part of this paper gives a short literature review, followed by a descriptive and empirical analysis of the demographic trends in EU countries. After the results are explained, the final conclusion follows.

Literature review

Demographic ageing of the population, the impact on fertility, demographic transition, and many similar demographic problems of the European countries have been analyzed in many papers. In order to examine the long-run relationship between fertility, mortality and income, Herzer et al. (2012), use panel cointegration for one-century data in order to conclude that mortality changes and growth of income contributed to transition to fertility.

Gender and active ageing in Europe was researched by Foster and Walker (2013). They state that demographic ageing creates challenges and that an active ageing strategy can provide a basis for countries to respond to the challenges presented by an ageing population.

Golini (1997) analyzes the demographic trends and ageing in Europe, where the main question is whether the present and future population trends in Europe will generate desirable and sustainable demographic paths.

The demographic determinants of population ageing are analyzed in the UN publication "World Population Ageing: 1950-2050" (2001). The most important findings in this paper are that people are living longer, yet large variations remain; regional differences in life expectancy at birth are expected to decrease; more people will survive to older ages; and gains in life expectancy are expected to be higher at older ages.

The population ageing determinants were analyzed by Gavrilov and Heuveline (2003), where fertility, mortality and migration are mentioned as key impact factors.

Turner (2009) examines the consequences of the ageing population and offers solution on a form of welfare optimizing model that takes into account the increasing years of healthy life, a slow rise in the pensionable age, capital inheritance, and wider welfare considerations of population density that are not reflected in GDP measures. He also states that solutions such as fixed retirement age and a need to raise fertility or increase immigration to maintain pensions at a fixed proportion of the GDP are overstated and wrong.

Demographic transition in Europe was analyzed by Hondroyiannis and Papapetrou (2002). They showed that cointegration relationship exists between fertility choice, infant mortality, real wages, and real per capita output. They agree with the theoretical finding of Sah (1991), Cigno (1998) and Becker et al. (1999) that - in industrial economies with low mortality - reduction in infant mortality will further reduce fertility.

Interesting findings about Europe's second demographic transition can be found in the work of Van de Kaa (1987).

Another interesting research about changes towards marriage and children can be found in the work of Lesthaeghe (1983). He talks about a long-term shift in the Western ideological system, where the changes in family formation and procreation are explained by the increasing centrality of individual goal attainment.

Surkyn and Lesthaeghe (2004) analyze the value orientations and the Second Demographic Transition in Northern, Western, and Southern Europe. They include values such as religiosity, ethics, civil morality, family values, social cohesion, expressive values, gender role orientations, trust in institutions, protest proneness and post-materialism, tolerance for minorities, and other. Very similar value profiles according to the position in the household are found in the three sets of countries.

As the problem of demographic ageing and changing of the norms and culture towards marriage and family are becoming increasingly important because of their influence on the society and the economy, numerous extensive research is made on this and similar subjects.

Analysis of demographic trends in EU countries

Figure 1 represents the evolution of the main demographic characteristics in 28 EU countries. The x-axis shows the time period from 1960-2015, the primary (left) y-axis illustrates the rate per 1000 people (refers to the birth and death rate), and the secondary (right) y-axis depicts the population (as % of total). Here is a brief comment for each EU country regarding the demographic trends:

Austria shows a significant increase in the percentage of old population over the young population starting from 2004 until present day, with the birth and the death rate closely overlapping and declining in the past two decades. These are all indicators of an ageing population with declining natality and relatively stagnant mortality. **Belgium** also marks an increase of the old over the young population starting from 2001 until present day, meaning the country is facing demographic ageing. Yet, on the good side, the birth rate keeps a steady trend over the death rate, indicating demographic potential for young population. **Bulgaria** has a serious and dramatic demographic situation. The old population is way beyond the young population starting almost two decades ago. Mortality has been surpassing natality in the past three decades, making Bulgaria a country with probably the worst demographic trends in EU, without input of young and working population. This is due mostly to the large emigration towards EU countries. **Croatia** is in a very similar situation as Bulgaria, with the difference that the negative trends here started a little later. Yet, the country suffers from majority of old population and death rate above the birth rate. **Cyprus** is one country where the demographic trends are better than in the other EU countries. The young population is more numerous than the old population, even though it is declining. The birth rate is well beyond the death rate, indicating demographic potential. The **Czech Republic** has had more old than young population in the last 10 years, and a death rate above the birth one in the past three decades, implying negative demographic trends. **Denmark** has been facing a situation of the older population outnumbering the young population only in the past few years. The declining natality rate is still greater than the mortality rate, pointing out to a relatively good demographic situation, yet with the potential for demographic ageing in the following years. **Estonia** has had the majority of its population at an older age for almost two decades in the past as well as a mortality rate higher than the natality rate in the past three decades, which is an indication of poor demographic development. **Finland** is very similar to Denmark - its old population has been in majority only in the past few years and it also has a declining birth rate that is still higher than the death rate. If these trends continue, the demographic ageing is about to take on this country. **France** is also a country with relatively good demographic development. The older population is just beginning to increase, and the declining birth rate is well beyond the death rate, which is better than most of other EU countries. **Germany** is suffering a significant demographic ageing of its population, with a constant increase of the old population and mortality rate beyond the birth rate for almost half a century. It is amazing how this country manages to achieve the economic development and it is considered as one of the leading EU and world economies, with a constant decrease of the input in the working force. This leads to the conclusion that immigration is one of the main factors that keep the economy to its high level. **Greece** has been having negative demographic trends in the past two decades and its older population well surpasses the young population, while its death and birth rate are equal to one another, indicating zero natural increase. **Hungary** has similar negative trends as most of the EU countries, i.e an increase of its older population and mortality rate as compared to the natality rate for almost past four decades. **Ireland** is a great exception from the other EU countries, with a high percentage of young population way above old population and with a birth rate much higher than the mortality one, indicating solid demographic development and potential for the workforce and the economy.

Figure 1 Demographic Trends in the EU countries

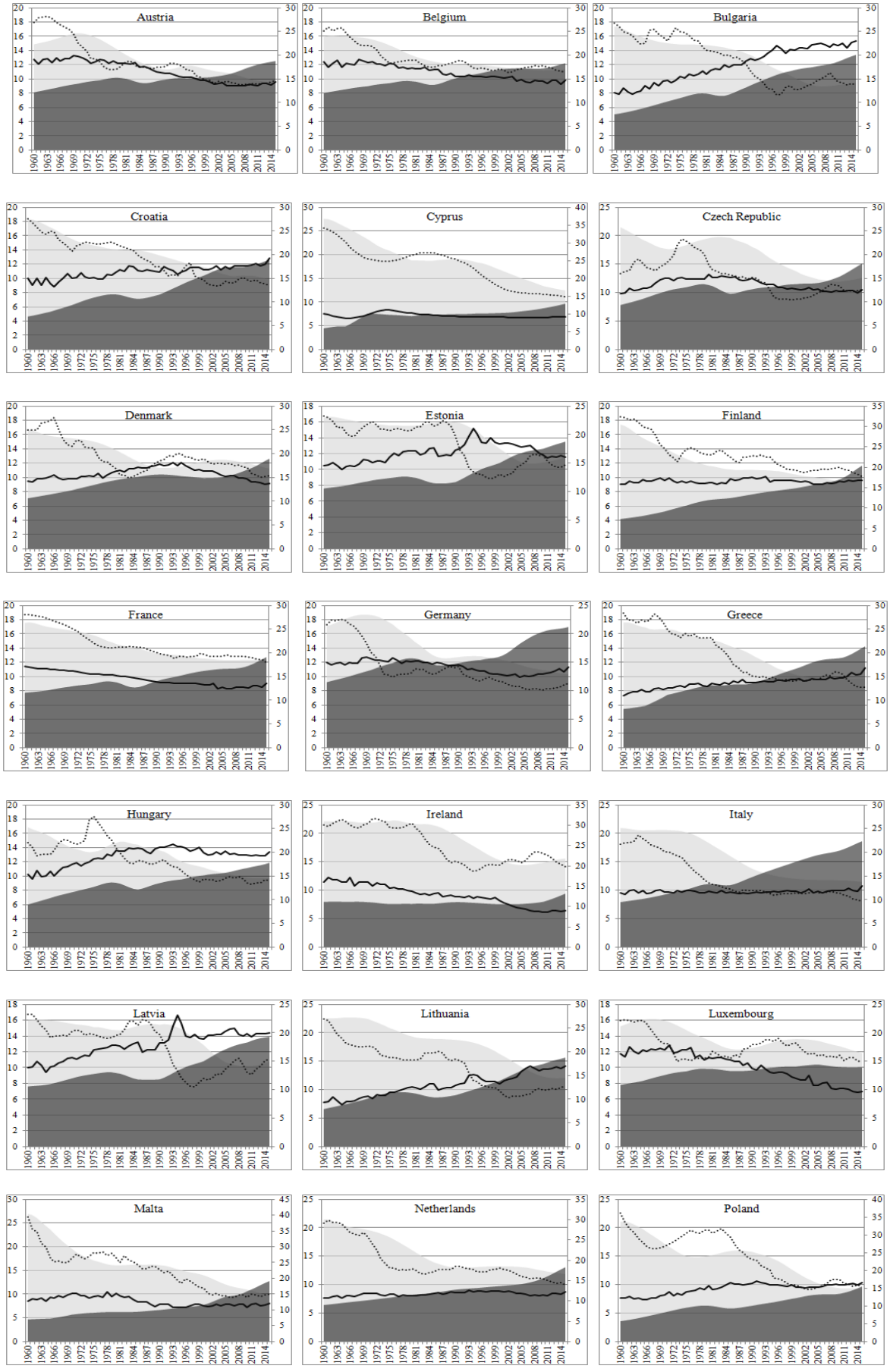
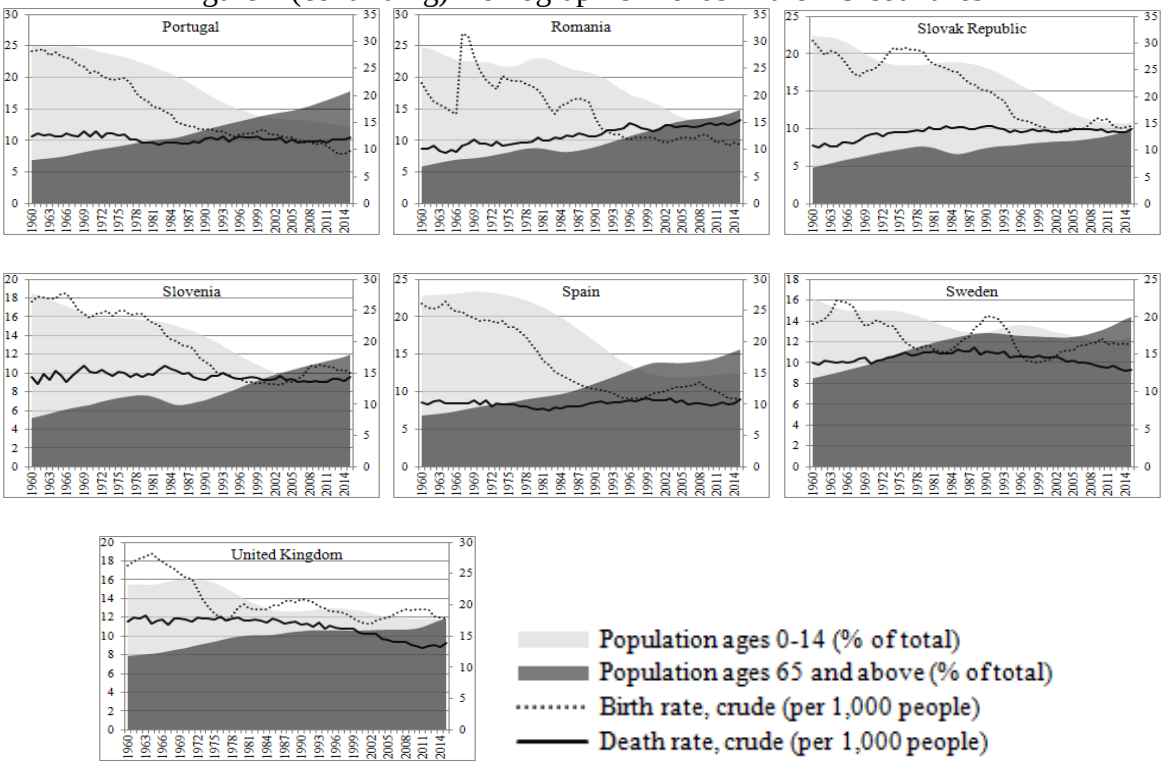


Figure 1 (continuing) Demographic Trends in the EU countries



Data source: World Development Indicators, World Bank, charts by the author

Italy is in a demographic situation similar to the other countries from the Mediterranean. For more than two decades, the old population exceeds the young population (just as in Greece) with zero natural increase.

Emigration is probably one of the main factors for such negative demographic trends. **Latvia** is suffering from the same demographic problems: older population more numerous than the young population and a death rate significantly higher than the birth one. **Lithuania** is in the same situation as Latvia. **Luxembourg** is one of the countries in EU that still has young population beyond the old population and positive natural increase, indicating positive demographic trends. **Malta** is just beginning to face the negative demographic trends, starting with an increase of its older population, even though the birth rate is higher than the death rate and the natural increase has been almost stagnant over the past fifteen years. **Netherlands** is similar to its neighbors, Denmark and Finland, indicating similar cultural and sociological aspects regarding family and children. It has a declining natality rate, yet still above the mortality one, and older population exceeding the young population only in the past several years. **Poland** is just beginning to have older population higher than the young population, even though it has had a zero natural increase in the past two decades. **Portugal** is similar to countries such as Greece and Italy regarding the negative demographic development. In the past two decades, its older population is more numerous than the young population. The birth rate is declining and is very close to the death rate, indicating zero natural increase. **Romania** has had more old than young population in the past decade, yet the mortality rate has been surpassing the natality rate for more than two decades. The **Slovak Republic** has a very similar situation to that in Poland, except with a slight increase in the birth rate in the last decade. **Slovenia** is having older population higher than young population in the past decade. There was a significant drop of natality rate in the 1980-1992 period, followed by a negative natural increase. From 2006 until today, there is again a trend of positive natural increase. **Spain** has had its older population surpassing its young population over less than two

decades, and a zero natural increase is just starting in the last period under observation. **Sweden** is having an increase in its old population, yet the birth rate is increasing while the mortality rate is decreasing, indicating a good demographic trend and potential for the working force. **United Kingdom** has relatively good demographic development, with its older population just starting to increase and with a birth rate way above the death one.

After analyzing the situation in all 28 EU countries, here are some general remarks about the demographic development in Europe: the EU is experiencing serious demographic ageing of the population. Common trends include older population well beyond the younger population, indicating issues with a dependency ratio of the population. Also, the birth rate is very close to or below the death rate. If the countries were illustrated trough their population pyramids, the shape would probably be a stationary or a constrictive pyramid, respectively. The author's observation is that the EU as a whole has a shape of a constrictive pyramid that is typical for a highly developed country, with high level of education, easy access to and incentive to use birth control, and good health care (Boucher, 2016).

All the countries can be classified in three groups:

- The first group is consisted of countries with the least favorable demographic trends, which last for few decades. The demographic situation can be described as critical. These countries are Bulgaria and Germany.
- The second group of countries has the same negative trends, yet not so severe or lasting for such long time periods as the first group. This group includes most of the countries - 15. This is the situation in Austria, Croatia, the Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Romania, the Slovak Republic, Slovenia, and Spain.
- The third group is consisted of countries with relatively good demographic development, or countries that are just beginning to suffer the negative demographic trends with a potential in terms of taking measures to rectify the situation. There are 8 countries in this group: Belgium, Denmark, Finland, France, Malta, Netherlands, Sweden, and the United Kingdom.
- The fourth group is small and encompasses all the countries within EU with positive demographic trends – a higher percentage of young population and high natality rate. These countries are Cyprus, Ireland, and Luxembourg.

Another interesting finding is that there is a group of countries that display similar demographic development mostly due to their close geographic proximity . Such are: the Mediterranean countries with a pronounced emigration element: Greece, Italy, and Portugal; countries from Northern Europe: Belgium, Denmark, Finland, the Netherlands, and Sweden. Geographical closeness also means similar cultural and sociological characteristics that influence the demographic development.

Data, Research Methodology and Empirical Results

The changes in factors that determine the natality in the countries of the European Union are represented by the following variables: the dependent variable is the birth rate ($birth_{it}$), crude (per 1000 people), while the independent ones are: death rate ($death_{it}$), crude (per 1000 people); old population (old_{it}), population at the of age 65 and above (% of total); young population ($young_{it}$), population ages 0-14 (% of total) (this is the group of demographic determinants); and GDP per capita (GDP_{it}), in current US dollars, as an economic determinant. The analysis includes 28 EU countries (Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland,

Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom. The data observed are in annual frequency for the period of 1960-2015 and are retrieved from the World Development Indicators data base of the World Bank.

For the data, the panel regression model was used, described in the following equation:

$$y_{it} = \alpha + \beta_{x_{it}} + u_{it}$$

where $y_{it}$is the dependent variable, α is the intercept term, β is a $kx1$ vector of parameters to be estimated on the explanatory variables, and x_{it} is a $1xk$ vector of observations on the explanatory variables, $i = 1, \dots, N$ and it stands for cross-sectional unit (number of countries), while $t = 1, \dots, T$ and it stands for the time period (Brooks, 2014).

The analysis was divided in two periods. The first period starts in 1960 and ends in 1990 (a period of 30 years), while the second one starts in 1991 and ends in 2015 (a period of 25 years). The idea behind this division is to have an approximately similar number of years in both models, as well as to distinguish between different cultural, sociological, demographical, economical, technological, and other conditions that have changed between the first and the second period. To explain better, for the first period, in the sixties, the effect of the baby boom is still present, where the natality rate is high and the percentage of the young population is well above that of the old population. Similarly, in the seventies and the eighties, the role of the woman, even though slowly changing, is still in most part that of a housewife and a mother. The technology is gradually developing, yet the biggest changes come in the nineties and the beginning of the 21 century, which is typical for the second period. Here the role of the woman is changing and is becoming more "carrier oriented". Women start to attend college more, pursuing carriers afterwards, and delaying the age of marriage and having children. Thus, natality slowly decreases, along with the percentage of young population, whereas the old population is increasing, normally as people age.

Table 1 Panel unit root tests

Period		1960-1990				1991-2015			
Method		LLC	Breuitung t-stat.	IPS	ADF-Fisher χ^2	LLC	Breuitung t-stat.	IPS	ADF-Fisher χ^2
Variables	Deterministic term								
$birth_{it}$	none	0.00			0.00	0.00			0.00
$death_{it}$	none	0.51*			0.79*	0.99*			0.08
old_{it}	none	0.90*			1.00*	1.00*			1.00*
$young_{it}$	none	0.00			0.00	0.05			0.06
GDP_{it}	none	1.00*			1.00*	0.10*			1.00*
$birth_{it}$	c	0.00		0.07	0.00	0.00		0.00	0.00
$death_{it}$	c	0.00		0.76*	0.03	0.44*		0.44*	0.13
old_{it}	c	0.00		0.04	0.01	1.00*		1.00*	1.00*
$young_{it}$	c	0.00		0.00	0.00	0.00		0.00	0.00
GDP_{it}	c	1.00*		1.00*	1.00*	0.03		1.00*	1.00*
$birth_{it}$	c, t	0.00	0.04	0.15*	0.00	0.00	0.39*	0.00	0.00
$death_{it}$	c, t	0.00	0.03	0.01	0.00	0.80*	1.00*	0.06	0.00
old_{it}	c, t	0.00	0.07	0.00	0.00	0.00	0.02	0.00	0.00
$young_{it}$	c, t	0.00	0.10*	0.00	0.00	0.00	1.00*	0.33*	0.03
GDP_{it}	c, t	1.00*	0.10*	1.00*	1.00*	1.00*	1.00*	1.00*	1.00*

Note: *Values ≥ 0.1 are marked
Source: Author's calculations

The mortality rate is not decreasing dramatically, due to the good health conditions in the developed EU countries, as well as due to the significant medical progress that prolongs

the life span. The introduction of internet in people's everyday lives brings about significant cultural and sociological changes, typical for the latter period. All this reflects on people's attitude towards family and marriage and is the reason why two models with the same variables were estimated.

Two panel regressions were run in order to compare the results and deduct if any changes in natality are present due to the changes that occur in the periods analyzed. The different results in the regressions may come from a complexity of factors: economical, cultural, social or technological determinants that change the human attitude to reproduction.

Before choosing the panel regression model, pre-tests for panel unit roots and Hausman test for cross-section effect specification were also run.

The panel unit root tests indicate that most of the variables are stationary (the results somewhat change depending on what type of test is performed and the deterministic term involved), except for the variable GDP_{it}; thus, this variable will be used as ΔGDP_{it} in the regression (first order integrated).

The Hausman test for cross-section effect specification for the first regression (1960-1990) indicates p-value of 0.00. For the second regression (1991-2015), the Hausman test has the same p-value of 0.00, indicating an estimate with fixed effect for both models. Here are the equations:

Equation 1 for the1960-1990 period

$$birth_{it} = \alpha + \beta_1 death_{it} + \beta_2 old_{it} + \beta_3 young_{it} + \beta_4 \Delta GDP_{it_{it}} + \lambda_t + \upsilon_{it}$$

where λ_t is a time-varying intercept that captures all of the variables affecting the dependent variable and varying over time, but being constant cross-sectionally (Brooks, 2014). Also, $i = 1, \dots, 19$ (8 countries are excluded due to insufficient GDP data), and $t = 1, \dots, 30$. The total number of observations in the first model amounts to 488.

Table 2 Panel regressions with fixed effects

Variable	Model 1 (1960-1990)	Model 2 (1991-2015)
Intercept	15.64 (0.00)***	6.66 (0.00)***
$death_{it}$	0.95 (0.00)***	0.21 (0.00)***
old_{it}	-1.33 (0.00)***	-0.07 (0.046)**
$young_{it}$	0.26 (0.00)***	0.18 (0.00)***
ΔGDP_{it}	0.00016 (0.01)***	-0.00 (0.79)
R^2	0.85	0.72
Durbin-Watson statistic	0.21	0.16

Notes: p-values in parentheses; *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Source: Authors calculations

Equation 2 for the1991-2015 period

$$birth_{it} = \gamma + \delta_1 death_{it} + \delta_2 old_{it} + \delta_3 young_{it} + \delta_4 \Delta GDP_{it_{it}} + \varepsilon_t + u_{it}$$

where ε_t is a time-varying intercept that captures all of the variables affecting the dependent variable and varying over time, but being constant cross-sectionally (Brooks, 2014). Also, $i = 1, \dots, 28$ and $t = 1, \dots, 25$. The total number of observations in the second model is 674.

The results from the panel regressions with fixed effects for both models are presented in Table 2.

Analysis of the empirical results

In the first model, the results show that all of the variables are significant and have an effect on the birth rate. The birth rate and the death rate have a positive relationship, and for the observed period this means that they are both declining (natality at a more intensive rate, while mortality is declining at a much steadier one). This is because, after the Baby Boom in the sixties, the attitude towards the number of children was changing in the seventies and the eighties very fast and shifted from large families with many children to families with an average of two children. The mortality rate is slow because the human life span is a biological determinant and cannot be changed, yet mortality is reduced by improved sanitary conditions, better health system, awareness about own habits and choices, better economic conditions, and many other factors.

The percentage of the old population has negative impact on the birth rate. This is a logical conclusion, since reproduction functions up to a certain age and not afterwards. As the population ages, there is no new input to the society and the working force, which brings about negative influence on the economic development, the health system, the pension system, and the other major systems of a specific country.

The percentage of the young population has the opposite effect than the old. When the percentage of young population is higher, natality increases, as proven by the first model. This means that there is good demographic development, especially in developed countries that can provide education and employment.

The previous three variables represent the demographic factors, while the last one, i.e. GDP per capita represents the economic factor. According to the model, when the GDP per capita is higher, the birth rate is also increasing. This is normal, because when people feel there is economic security, it is easier for them to decide to have (more) children, knowing they will be provided for.

The second model shows slightly different results regarding the economic factor. Apparently, the demographic variables have the same effect on the birth rate, despite the sociological, cultural, and technological changes. The death and the birth rate are still positively related, meaning they continue to decrease. Emancipation of women and their inclusion in the education and the working force changed their attitude towards marriage and children, decreasing the natality even more. On the other hand, significantly improved medical conditions and people's awareness of their own life style and health habits reduces the mortality rate. Just as a note, a dramatic decline in the birth rate is typical for the first period. In the second period, this decrease is very slow or steady in some countries. The percentage of the old population has negative impact on the natality rate, just as in the first model. As the percentage of old people increases, the birth rate decreases. Young population and birth rate have positive statistical dependence, or in this case, they are both declining. The young population experiences a more dramatic fall in the second period, while the birth rate had been dropping more rapidly in the first period. Regardless of the intensity, they are both declining over the whole period of observation, indicating a serious problem for the EU countries, their work force potential, and their further economic development.

As regards the economic factor, it appears that it does not have significant statistical influence on the birth rate in the EU countries in the second period. One explanation for this situation is that the cultural (and psychological) changes in the attitude towards marriage and children is so drastically changed and embedded in the human behavior of the developed countries, that the good economic conditions are not a sufficient incentive for starting a family or expanding it with more children. People like to devote themselves to personal development by education, professional achievements, and hobbies and travel, slowly leaving the traditional concept of marriage and family. This very much corresponds to the work of

Van de Kaa (1987), where the second demographic transition is explained as a dramatic shift in the norms toward progressiveness and individualism, which moves Europeans away from marriage and parenthood. He states that cohabitation and out-of-wedlock fertility are increasingly acceptable, and having a child is more and more a deliberate choice made to achieve greater self-fulfillment.

Conclusion

The results in this paper only confirm a well-known fact: Europe is facing serious demographic ageing, which affects negatively on the economy, the pension system, the health system and has many other unfavorable consequences. The population is ageing and not reproducing sufficiently mainly because of the changes of the norms, cultural and social views on marriage and children. It would not be naive to think that there are measures and policies to be taken to reverse this process and make people leaving their carriers and creating families with more than two children. Europe is not going to face another baby boom. People will not change their attitudes towards marriage and family overnight. So, it is important to embrace the new cultural norms and find a proper solution in these new circumstances. Van de Kaa (1987) believes that only measures that are compatible with the shift to individualism might slow or reverse the fertility decline, but a rebound to a replacement level seems unlikely and a long-term population decline appears inevitable for most of Europe.

There is also an additional solution that some of the countries (like Germany and United Kingdom) have been practicing in the past few decades – immigration. Lacking workforce themselves, they are open to receiving immigrants from other EU countries (mostly from Eastern and Southern Europe), and as of lately Germany received significant number of immigrants from the war zones in the Middle East. The developed countries with strong and leading economies are always attractive destinations for the emigrants from less developed economies. The important problem that needs resolution is what is going to happen to the less developed countries (like in the South-Eastern Europe) that are also facing demographic ageing, large emigration towards Western European countries, and no input in the workforce from its own population, nor from immigration, since these countries are not desirable for the immigrants when there are far more possibilities in the developed economies.

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ДЕМОГРАФСКОТО СТАРЕЕЊЕТО НА ЕВРОПА И НЕГОВОТО ВЛИЈАНИЕ ВРЗ СТАПКАТА НА НАТАЛИТЕТ

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Апстракт

Во овој труд се анализира демографското стареење во земјите од Европската Унија во изминатиот половина век. Два модели на панел регресија се користат со цел да се утврди влијанието на стапката на морталитет, процентот на младо население, процентот на старо население и БДП per capita врз стапката на наталитет. По раниот период (1960-1990) сите демографски фактори и економскиот фактор БПД per capita имаат статистички значајно влијание на стапката на наталитет. Во подоцниот период (1991-2015) само демографските фактори имаат значајно влијание на наталитетот.

Ова истражување вклучува и дескриптивна анализа за секоја земја од ЕУ, поединечно, и ги групира земјите во четири групи (од земји со најнеповолни демографски трендови до земји со позитивни демографски трендови).

Во целина, овој труд дава преглед на демографското стареење на популацијата во земјите од Европската Унија, ги објаснува причините и последиците кои се должат на оваа ситуација, како и можните решенија.

JEL класификација: J1, J11, J13, C23

Клучни зборови: стапка на наталитет, стапка на морталитет, демографски трендови, земји од ЕУ, панел регресија