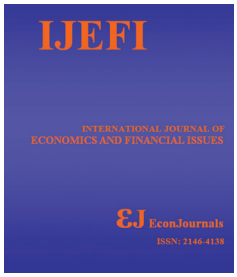

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The Economic Impacts of Aging Societies

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ABSTRACT

Changes occurring in the health sector and in terms of society within the last 100 years in the world has extended the life expectations at the time of birth and decreased the birth rates. These changes have been experienced especially in developed countries rather than the underdeveloped and developing countries. The aim of this study is to make the determination of the economic effects of growth by using panel data analysis method for 2000-2014 period in 19 developed countries consisting of USA, Canada, England, Germany, France, Japan, Belgium, Australia, Luxembourg, Switzerland and Denmark. The panel corrected standard errors regression test results show that the income per capita is directly proportional with the income per worker and labour force total participation rate (LFTP). So when the average of age increases LFTP decreases and this affects negatively the national income of countries.

Keywords: Aging, Labour Force Participation Rate, Panel Data Analysis
JEL Classifications: J11, J21, C23

1. INTRODUCTION

Over the past two centuries, improvements in nutrition, sanitation and health care have dramatically reduced infant mortality and extended the life expectancy of children and adults throughout the world. The continuation of low rates of fertility and reductions in mortality rates of the elderly have revived the interest of economists in the examination of the economic impacts of aging populations.

Each country's demographic transition typically involves several major phases whose duration depends on the timing and pace of changes in mortality and fertility. Other developments for example, political, economic or environmental disruptions and post-war baby booms can change the age structure of country's population in similar ways as well.

Today almost all country societies get older in the world. But developing countries are getting older faster than the other societies. Low birth rates and decreasing death rates in old ages in developing countries societies get older and this took attention of economists.

Population aging in developed economies is the result of two events. The first one is; today people live longer than in the past because developed medical opportunities decrease the death rates from illnesses. So when people get older they live longer. The second is; fertility rate in both developed and developing countries decrease. As a result of this while the bottom layers of the population pyramid aren't extending, upper layers stating the older ages are extending continuously.

These developments are expected to have widespread economic effects, through both size and age distributional channels. Indeed, population aging will be a pervasive force affecting the structures of industrialized economies in many ways, through its impacts on labor markets, the structure of demand, the national rate of saving and capital accumulation, etc.

An obvious question that arises is whether population aging will be favorable or not to economic well-being. Will aging have a positive or negative impact on per capita income? This paper's purpose is establishing the per capita income effects of societies' population aging.

2. GLOBAL POPULATION PROJECTION

In this part, population data from the past and today will be compared with the future demographic expectations. According to the United Nations data the share of 60+ and 80+ age groups are so high than ever before and the increase rates continue to speedup. While the population total of 60+ was 200 million people in 1950, this number has reached 760 million in 2015.

In Figure 1, the past values and projections of 65+ group for selected developed countries (USA, England, Canada, Germany, Holland and Japan).

According to Bloom et al. (2011) there are two main reasons of this increase in 65+ group. The first one is low birth rates. The total birth rates. The total birth rates can be seen at the Appendix 1.

While birth rates were 3 children per woman in 1950, this number has decreased to 2 in 2005 and it is predicted that it will decrease to 1.7 in 2050 and 1.5-1.6 child in 2100. Countries in which this decrease is happening a lot are countries which are at the top steps of the economic developing index.

The second key factor is the increase in the expectancy of life. Figure 2 shows the expectancy of life in selected developed countries at the time of birth.

While life expectancy at the time of birth for men was 65 in 1950, this number reached 76-78 in 2000. It is expected that this number will reach 84-86 in 2050 and 90 in 2100. While the average was age 70 in 1950 in women, it reached age 80-82 in 2000. It is expected that the life expectancy at the time of birth in women will reach over 90 in 2100.

As the improvements in life expectancy (both in the male and female) are a result of improvements in mortality rates across all of the age groups, the proportion of individuals in each age group does not change much even in the face of such steep life expectancy improvements. However, fertility improvements are concentrated in the 0 to 1 age group, which leads to an immediate effect on age structure (Bloom et al., 2010).

Related to the factors showed in Figures 1 and 2, the elderly population dependency rates are increasing fastly. Loumrhari (2014)'s econometric estimates show that if the increase in the dependency ratio negatively affects the growth rate of savings.

The dependency graphic showing in Appendix 2 how many people over the age 65 belongs to each 100 people between the age 15 and 64.

While this rate was 15% in 1950 in selected countries, this rate increased to 20-25% in 2000; it is expected that it will reach 45-50% in 2100.

A change in the fertility, life expectancy and mortality rates has a cohort effect that will have an instantaneous on age structure. Importantly, this effect will persist through the age distribution as cohorts move through the different age groups. These population dynamics imply that changes in the 1950-2015 period, will continue to affect the age structure through the 2050 to 2100 period as can be seen in the Figures 3-8.

The effects of this development are being observed in the changes of the population pyramid structures. Figures 3-8 shows the population pyramid in 1950 and 2015 and the population pyramid projections of 2050 and 2100 for USA, Canada, England, Germany, Holland and Japan.

As it is seen in Figures 3-8 in 1950 the population structure was large in terms of both women and men base so as to say in young population, it was becoming narrow in older ages. But in 2015 while the base of the pyramid showed a little enlargement, it started to enlarge in the middle and upper part. Projections made for 2050 and 2100 it is predicted that the upper part of the pyramid (especially 65+) will enlarge.

For example, in USA 10 million and 45 million people over 65, respectively 1950 and 2015. But 90 million and 110 million people over 65 respectively 2050 and 2100. Dramatic increase can be seen observed due to the low mortality rates and high life expectancy rates.

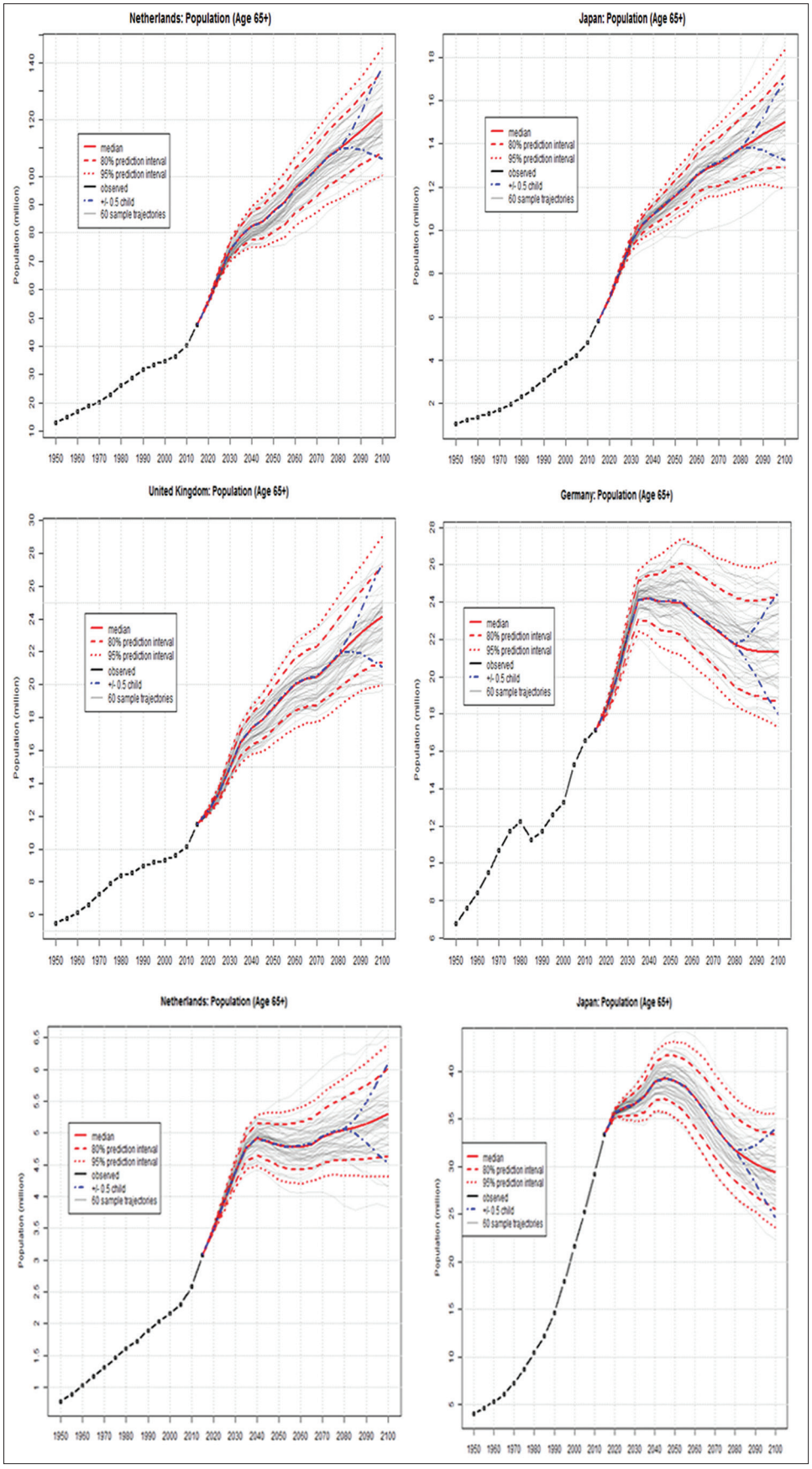
3. THE ECONOMIC CONSEQUENCES OF POPULATION AGING

Slow population growth will bring a less labour power and low national production. But income per capita is more important than the national economy size. Because income per capita is more successful by stating the life standard.

Slow population growth decreases the saving rates, so it narrows the efficiency investments of workplaces. Slow population growth also decreases the efficiency by affecting the labour power quality. The total affect of this two aspect can reach serious dimensions unless measures are taken (Feldstein, 2006. p. 2).

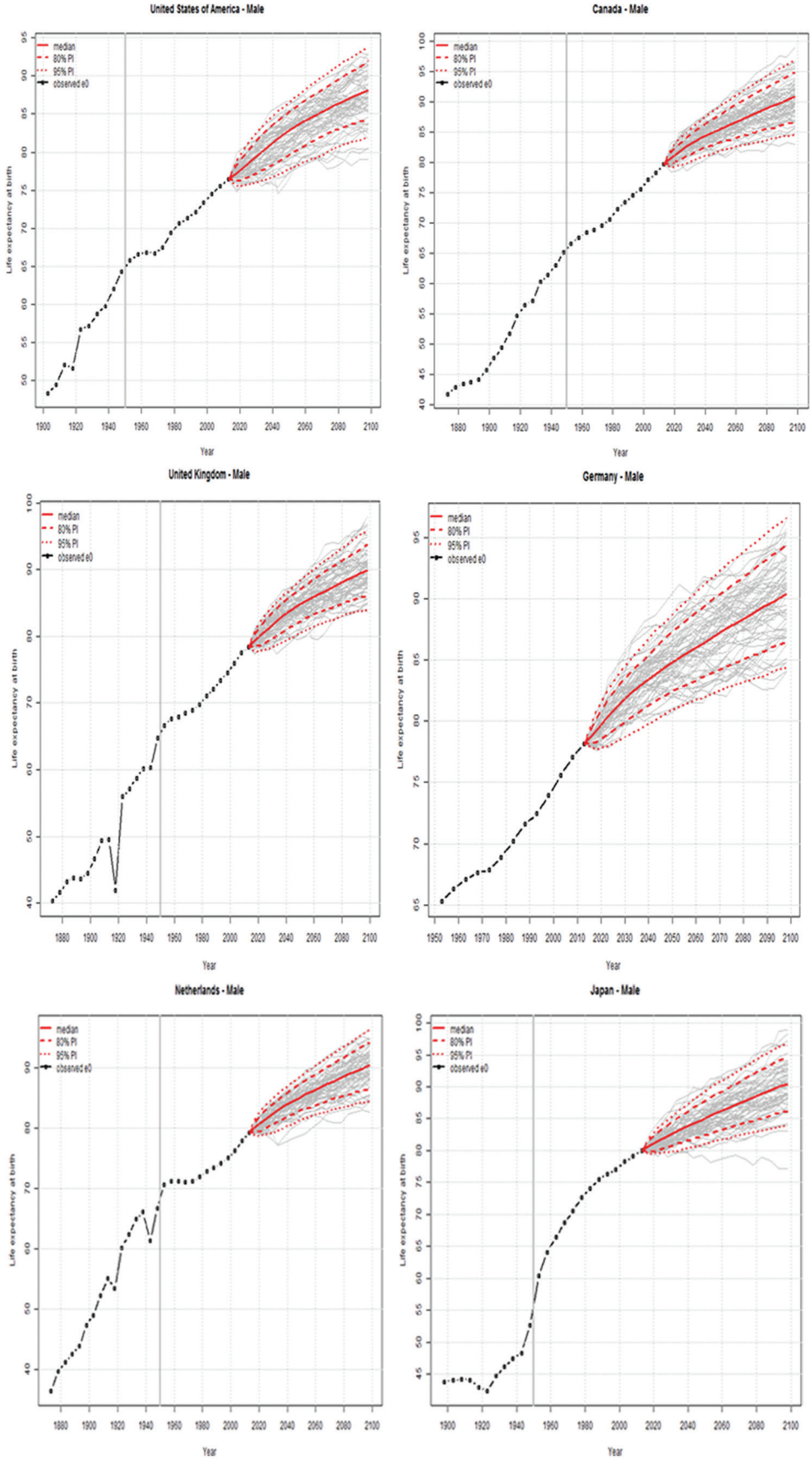
According to Feldstein (2006) if we deal with the low population increase rate, some of the household will be saver and some of them will make negative savings. Savers consist generally of middle aged workers preparing for pension. Persons making negative savings are the ones being in pension term. In a developing economy, there are more middle aged savers. In a society having increasing income per capita, the saving amount of savers exceeds the amount of negative savers. So, this will bring also positive saving rates in these countries. A rapid population growth rate will increase the saving rate of society. Low population increase in developing countries and a older society will cause decrease of savings. The decrease in savings will direct countries to import capital in order to close saving opening. But this two situation which are possible theorically cannot be possible in practice. The first one is the aging problem caused by the low population increase speed. The second problem is to show that saving in developed countries turns into investment in the country in which saving is made.

Figure 1: Population aged over 65+



Source: UN, Department of Economic and Social Affairs, Population Division

Figure 2: Life expectancy at birth (Male)



Source: UN, Department of Economic and Social Affairs, Population Division

Since this change in savings can increase the interest rates, making less investment by going to equipment and facility will decrease the capital intensity of economies. So the productivity of workers and national income will decrease. In addition to this low investment rates will make difficult to apply new technologies and this will limit efficiency increases.

Labor force with a high age average decreases efficiency increase directly. Each new generation gains more than the previous one. One reason of this is the increase in education level and new skills transferred to the working life with new generation. For example the skill of using internet and computer of new generations is higher than the previous ones. So, an aging society and aging labour force affects negatively efficiency.

Another economic result of aging of the 21st century societies happen on pension programs. The basic reason of the existence of these programs is that it is felt necessary to share this increase with people being a part of labour force previously. Design of the pension system worldwide is in various ways. The common part is that each of them are a consumption and spending distribution mechanism. Here the important thing is that the goods and services produced by the population having an active distribution part is distributed correctly to the employees completed their working life.

Dependency rate is on the focus point of the negotiations about pension systems. Basic problem is that most people in an aging society is at the consumer position. Consumers not making production are dependent on the work force making goods and service production. So, pension systems offer the opportunity to elderly people to continue their consumption without participating directly to the economic production capacity. So, when the age average continues non active population rate per working population will increase.

Labor force participation rates in certain countries, are directly related with the average pension age.

Graph 1 shows the labour force participation rates according to age groups between 2000 and 2019 for selected countries (USA, Canada, England, Germany, Holland and Japan). As it can be seen from the graphic while the age groups increase, work force participation rates decrease rapidly in all countries.

As it is stated in the World Economic Forum (2004) life expectancy rate in most developed countries has increased at the last quarter of the 20th century. Since people live longer and get retired early, the costs of pension systems have increased. Due to the fact that population in developed countries get older, passive person number within the economic system will increase. In order to finance these high costs tax rates will be increased and if measures are not taken in terms of aging this can reach serious dimensions. Increases to a large extent in tax rates will have negative effects on economy. If we deal with payroll taxes taken from prices, even these tax increases will be paid by employers, it will cause a narrowing in employment. In addition, in order to protect the profit, employers shall give low hourly rate. This decrease in prices will decrease the increase rates in incomes before tax. Accordingly, the labour force showed by the workers will decrease and output and total labour force income will decrease. Necessary funds for the financing of the pension system cannot be taken only over price so corporate taxes rates will increase. High taxes on the investment incomes will decrease the investment profit rate and extend the investment cost return periods, so the new equipment and facility investment amount will decrease.

Another macroeconomic effect of society aging is the effect to the vertical and horizontal socio economic movement. When every other things are fixed (ceteris paribus) horizontal movement is inversely related with age depending on the physical situation, meeting the mobility cost and benefit acquired from mobility (Clark et al., 1978. p. 947).

According to Miller (1977) under modern conditions, migration tendency is affected from certain factors like education and labour force situation. Also it has been determined that elderly people give different reactions to the factors affecting migration decisions rather than younger people.

In Serow (1976) study it has been determined that in elderly workers birth place is the main determinant of immigration and immigration to birth place is preferred, in young workers it has been determined that birth place factor has not any importance. In the Schwartz (1973) study it has been determined that while there was a positive relation between the immigration rate and education level, there was a negative relation with age level. So while the age level increases, vertical mobility is limited and a more stationary society is acquired. Another economic affect faced in the age structure in the society happens in financial markets. These effects have been organized like this in Poterba (2004) study:

- First affect shows up with the change faced in existence value. While the age rate approaches 65, existence value decreases rapidly in the country.
- The second effect is related how the changes in the public sector affects the private markets. As a result of belt tightening policies, pension incomes will decrease and this will lead elderly persons to decrease their assets. This change in the government policies will affect the individual health savings and so the financial product demand.

4. ECONOMETRIC METHODOLOGY

Different types of data are generally available for empirical analysis, namely, time series, cross section and panel. A data set containing observations on a single phenomenon observed over multiple time periods is called time series. In time series data, both the values and the ordering of the data points have meaning. In cross section data, values of one or more variables are collected for several sample units, or entities, at the same point time. Panel data sets refer to sets that consist of both time series and cross section data. This has the effect of expanding the number of observations available. For instance, if we have 10 years of data across 10 countries, we have 100 observations. So although there

would not be enough to estimate the model as a time series or a cross section, there would be enough to estimate it as a panel. Panel data can be in either a balanced or unbalanced format, a balanced panel is where there is an observation for every unit of observation in time series and unbalanced where observations are missing.

This study uses panel data methodology because of its benefits. Hsiao (2014) listed several benefits from using panel data. These include the following:

- Panel data involve two dimensions; a cross sectional dimension N, and a time series dimension T.
- Panel data usually give the researcher large number of data points (N*T), increases the degrees of freedom.
- Controlling for individual heterogeneity. Panel data suggest that individuals, firms, states and countries are heterogeneous. Time series and cross section studies not controlling this heterogeneity run the risk of obtaining biased results.
- Panel data give more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency. Time series studies are plagued with multicollinearity. With additional, more informative data one can produce more reliable parameter estimates.
- Panel data are better able to study the dynamics of adjustment. Cross sectional distributions that look relatively stable hide a multitude of changes. Spells of unemployment, trade, job turnover, residential and income mobility, are better studied with panels. Panel data are also well suited to study the duration of economic states like unemployment and poverty, and if these panels are long enough, they can shed light on the speed of adjustment to economic policy changes. For example, in measuring unemployment, cross sectional data can estimate what proportion of those who are unemployed at a point in time. Repeated cross section can show how this proportion changes over time. Only panel data can estimate what proportion of those who are unemployed in one period can remain unemployed in another period. Deaton (1995) argues that, unlike cross sections, panel surveys yield data on changes for individuals or households. It allows us to observe how the individual living standards change during the development process.
- Panel data are better able to identify and measure effects that are simply not detectable in pure cross section or pure time series data.
- Panel data models allow us to construct and test more complicated behavioural models that can purely cross section and time series data.
- Micro panel data gathered on individuals, firms and households may be more accurately measured than similar variables measured at the macro level. Biases resulting from aggregation over firms or individuals may be reduced or eliminated.
- Macro panel data on the other hand have a longer time series and unlike the problem of nonstandard distributions typical of unit root tests in time series analysis.
- Panel data have also become increasingly available in developing countries. In these countries, there may not have a long tradition of statistical collection.

The empirical analysis starts with cross sectional dependency test (CSD). A growing body of panel data literature concludes that panel data models are likely to exhibit substantial CSD in the errors, which may arise because of the presence of common shocks and unobserved components that ultimately become part of the error term, spatial dependence idiosyncratic pair wise dependence in the disturbances with no particular pattern of common components or spatial dependence.

The impact of CSD in estimation naturally depends on a variety of factors, such as the magnitude of the correlations across cross sections and the nature of CSD itself. Assuming that CSD is caused by the presence of common factors, which are unobserved (and as a result, the effect of these components is felt through the disturbance term) but they are uncorrelated with the included regressors, the standard fixed effects (FE) and random effect (RE) estimators are consistent, although not efficient, and the estimated standard errors are biased. In this case different possibilities arise in estimation. On the other hand, if the unobserved components that create interdependencies across cross sections are correlated with the included regressors, these approaches will not work and the FE and RE estimators will be biased and inconsistent.

In the study, three CSD tests have been applied. These are Pesaran's CD test, Friedman's test and lastly Frees' test. In the study Pesaran test looking at the correlation existence among units (2004), Friedman test which is not parametric and calculates average value by using the rank correlation factor and Frees test which is based on the sum of the squares of rank correlation factors (1995) have been used (Tatoğlu, 2013. p. 218-219).

In all three tests, under the null hypothesis u_{it} is assumed to be independent and identically distributed over time periods and across cross sectional units. Under the alternative may be correlated across cross sections.

Thus hypotheses are:

$H_0=\rho_{ij}=\rho_{ji}=cor\,(u_{it}, u_{jt})=0$ for $i\neq j$

$H_1=\rho_{ij}=\rho_{ji}\neq 0$ for $i\neq j$

Where ρ_{ij} is the product moment correlation coefficient of the disturbances and is given by:

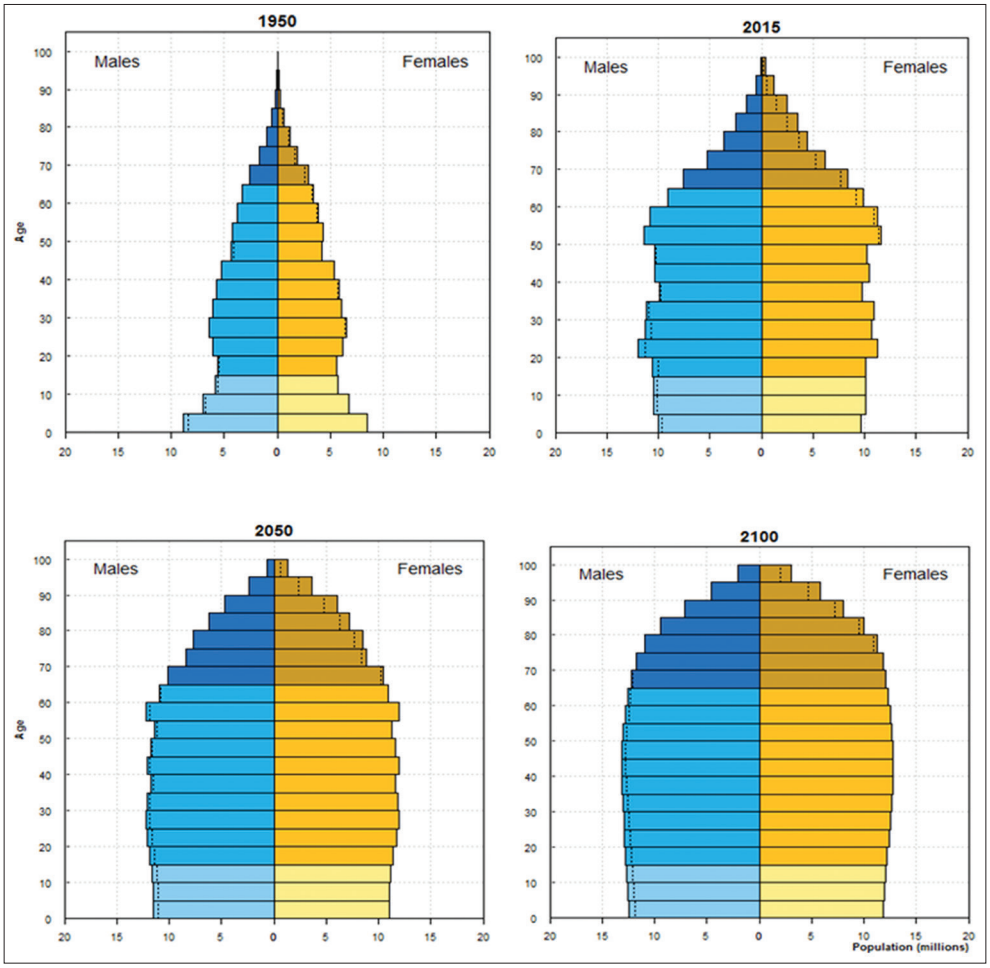
$$p_{ij} = p_{ji} = \frac{\sum_{t=1}^{T} u_{it}u_{jt}}{\left(\sum_{t=1}^{T} u_{it}^2\right)^{1/2}\left(\sum_{t=1}^{T} u_{jt}^2\right)^{1/2}}$$

CSD test results have been shown in Table 1.

As stated in Table 1, according to Pesaran, Friedman and Frees' Cross Section Dependency tests, cross section dependency has been determined in this sample group. In the next part of the study, heteroscedasticity test and then auto-correlation test will be

1 According the Frees CSD test, if calculated test statistic is greater than critical values, CSD has been determined.

Figure 3: Population pyramid for USA



Source: UN, Department of Economic and Social Affairs, Population Division

applied. Towards the results of these tests panel corrected standard errors (PCSE) regression results will be acquired.

Analysis with annual data for 2000-2014 in 19 countries consisting of USA, Canada, England, Germany, France, Spain, Italy, Austria, Portugal, Holland, Sweden, Sweden, Norway, Finland, Japan, Belgium, Australia, Luxembourg, Switzerland and Denmark has been made. Data have been acquired from World Bank, World Development Indicators (http://data.worldbank.org/indicator).

According to Bloom et al. (2011) so as the effects of aging on economic growth can be understood better, we have to divide the total current growth between 2000 and 2014 per worker gross domestic product (GDP) and labour force total participation rate (LFTP). Since the income per capita is acquired by dividing GDP into population, per worker GDP can be acquired by dividing GDP into work force.

$$\frac{GDP}{W}=\frac{GDP/P}{W/P}=\frac{GDP/P}{LFTP} \quad (1)$$

In Equation 1, GDP means gross domestic product; W means the total labour power in the country; P means total population; LFTP means the labour force total participation rate. If we take the logarithm of Equation 1;

$$\ln\left(\frac{GDP}{W}\right)=\ln\left(GDP/P\right)-\ln\left(LFTP\right) \quad (2)$$

According to Equation 2, the reel income enlargement per capita between t and t+1 periods can be predicted with the help of Equation 3;

$$g_{t,t+1}=\left[\ln\left(GDP_{t+1}/W_{t+1}\right)+\ln\left(LFTP_{t+1}\right)\right]-\left[\ln\left(GDP_{t}/W_{t}\right)+\ln\left(LFTP_{t}\right)\right] \quad (3)$$

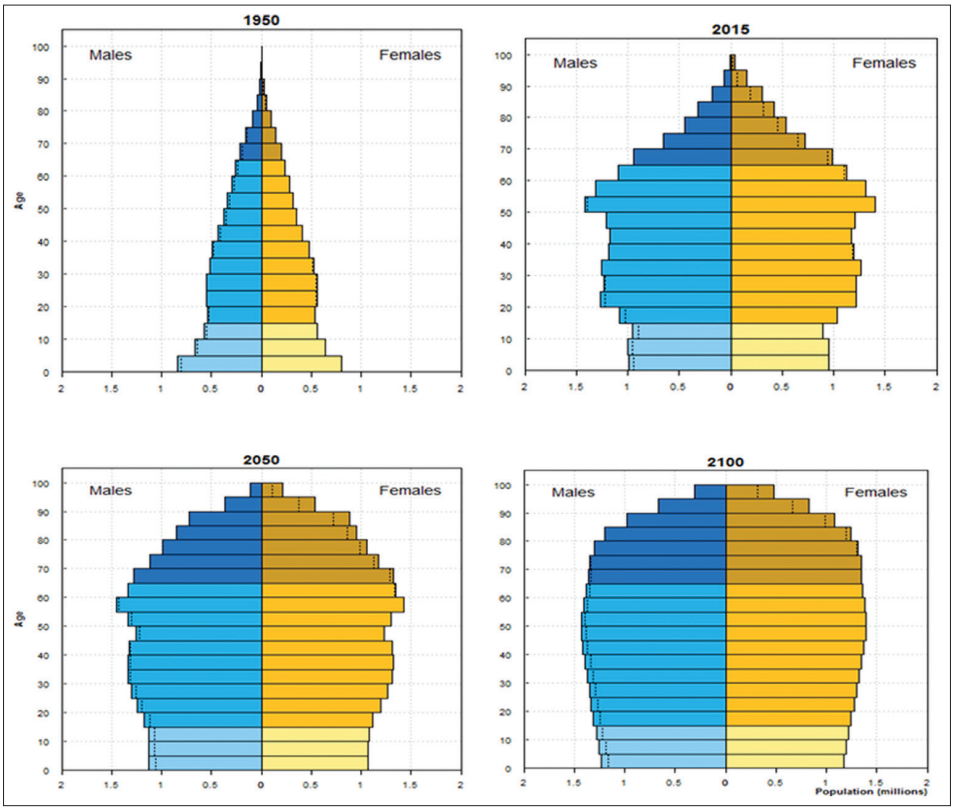
If we simplify Equation 3;

$$g_{t,t+1}=\ln\left(\frac{GDP_{t+1}/W_{t+1}}{GDP_{t}/W_{t}}\right)+\ln\left(\frac{LFTP_{t+1}}{LFTP_{t}}\right) \quad (4)$$

Equation 4 shows that growth in per capita income can be divided into two as per worker income and LFTP growth.

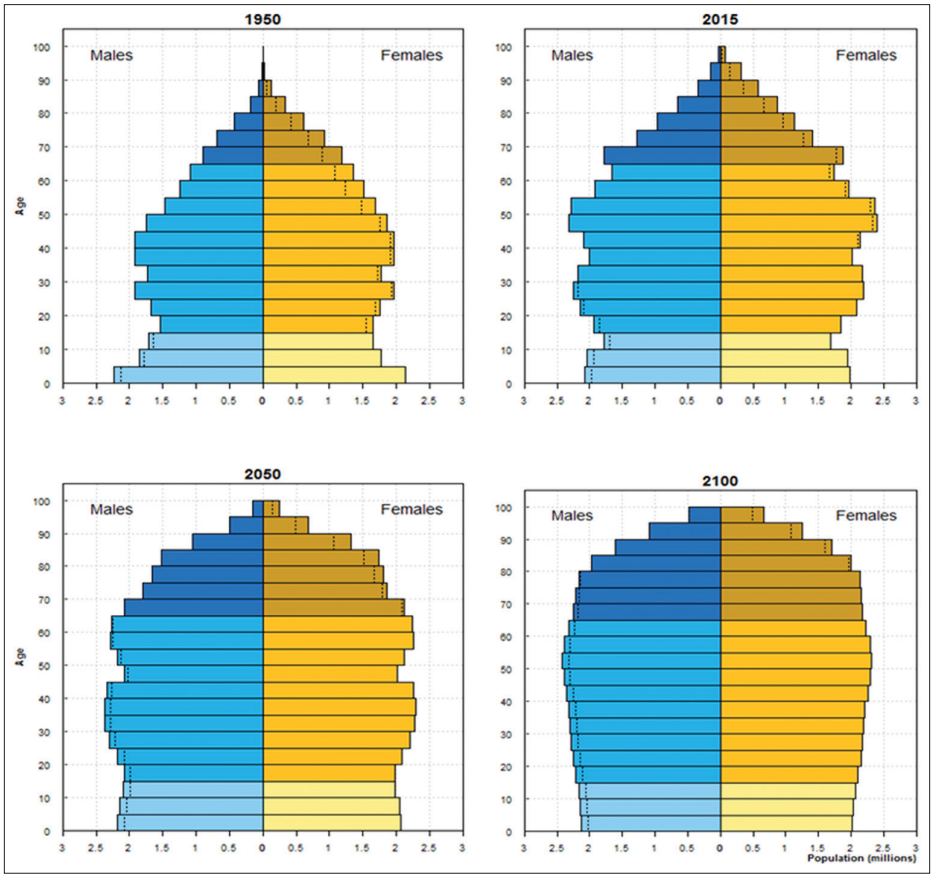
PCSE regression method will be used for the prediction of Equation 4. According to Tatoğlu (2013) the phases of PCSE method is as follows:

Figure 4: Population pyramid for Canada



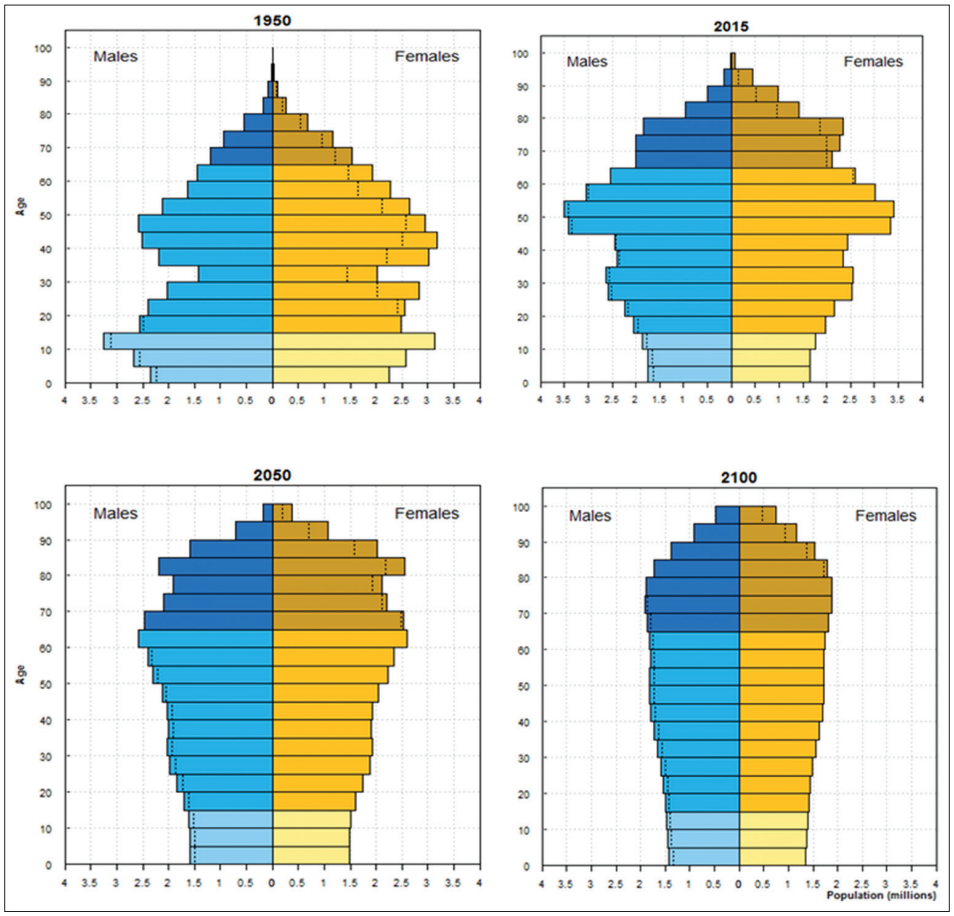
Source: UN, Department of Economic and Social Affairs, Population Division

Figure 5: Population pyramid for U.K



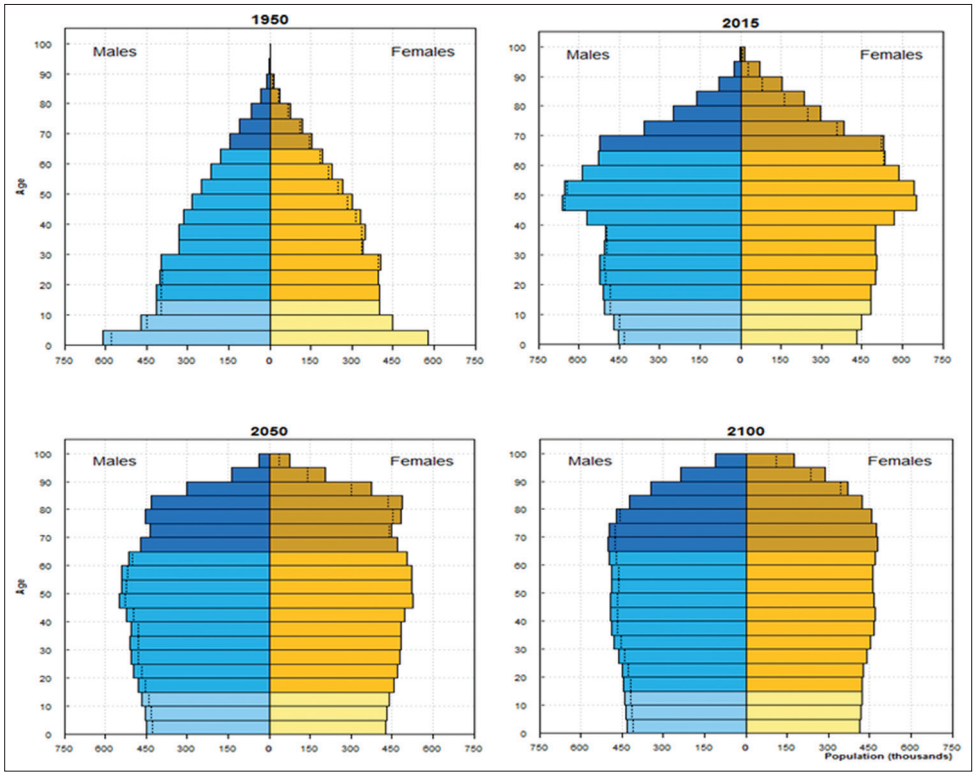
Source: UN, Department of Economic and Social Affairs, Population Division

Figure 6: Population pyramid for Germany



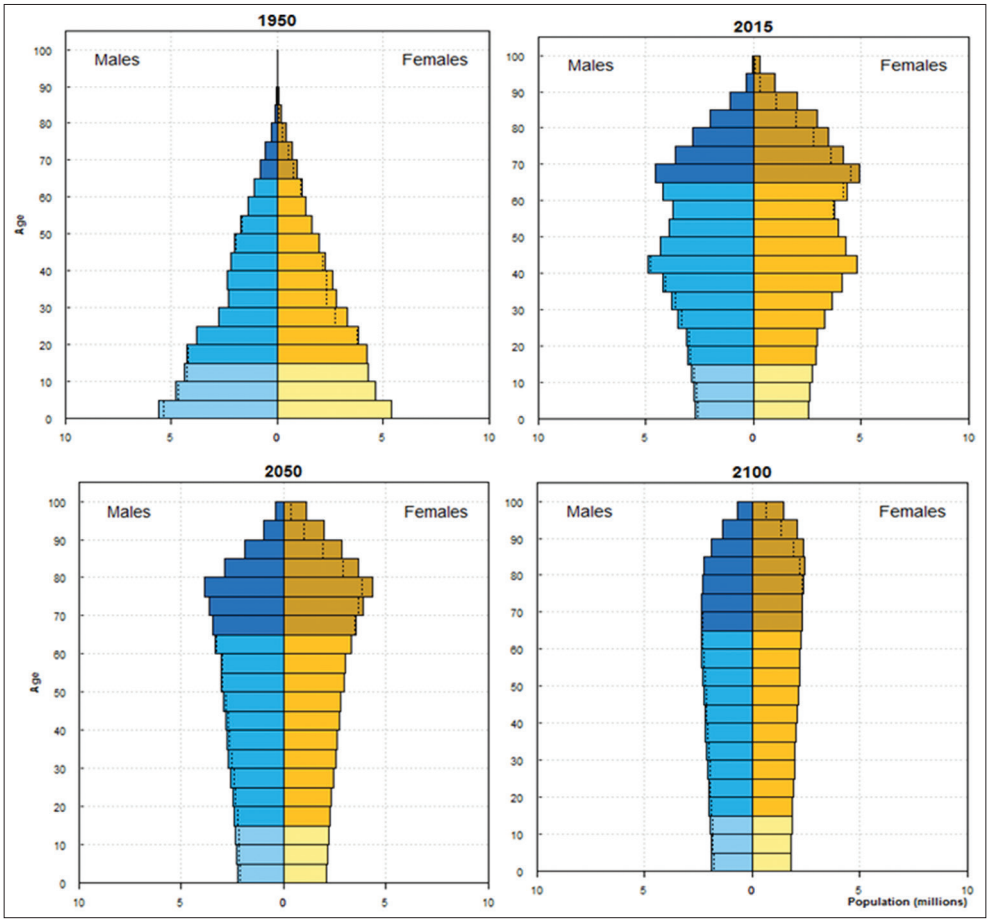
Source: UN, Department of Economic and Social Affairs, Population Division

Figure 7: Population pyramid for Netherlands



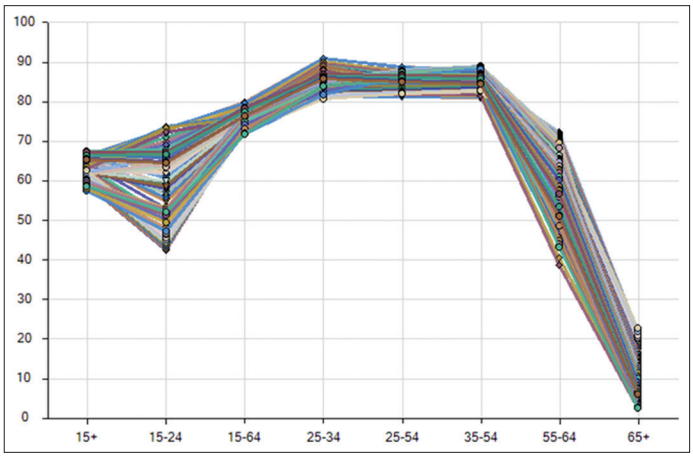
Source: UN, Department of Economic and Social Affairs, Population Division

Figure 8: Population pyramid for Japan



Source: UN, Department of Economic and Social Affairs, Population Division

Graph 1: Labour force participation rate by age groups (%)



Source: Authors' own calculation form ILO database

- Model is predicted with the least squares method.
- Right predictions of β's standard errors are predicted by using PCSE.
- If residuals have auto correlation, regression results are acquired by using Prais-Winsten type basic correction methods.

Before PCSE regression, time series properties test results can be seen at Table 2. The results show that series have no autocorrelation, but have heteroscedastic features. PCSE regression commands are fixing according to these results

Table 1: CSD test results

Test	Statistical value	Probability value
Pesaran test	27.830	0.000
Friedman test	134.279	0.000
Frees test	4.281[1]	Critical values from Frees' Q distribution 0.1719 for 0.10 0.2262 for 0.05 0.3351 for 0.01

CSD: Cross sectional dependency

Table 3 shows PCSE regression test results. Test results shows that all factors of variables are statistically significant. According to this, 1% increase in growth in income per worker increases income per capita 0.99%. at the same time 1% increase in LFTP increases income per capita 1% unit.

Regression test results show that income per capita in the country is directly proportional with the income per worker and LFTP. While the age average of countries increases especially the decreases in LFTP will affect negatively the national incomes of countries.

Table 2: Wooldridge and modified wald test results

Test	Calculated test statistic	Probability value	Null hypothesis	Result
Wooldridge autocorrelation test	1.823	0.1937	No first order autocorrelation	No autocorrelation
Modified Wald test	954.85	0.000	No heteroscedasticity	Heteroscedastic

Table 3: PCSE regression test results

Series	Coefficient	Standard error	P>|z|
GIPCW[2]	0.9957	0.0035	0.000
GILFTP[3]	1.0036	0.0051	0.000
Constant	1.0002	0.0007	0.000

PCSE: Panel corrected standard errors

5. CONCLUDING REMARKS

Changes occurring in the health sector and in terms of society within the last 100 years in the world has extended the life expectations at the time of birth and decreased the birth rates. These changes have been experienced especially in developed countries rather than the underdeveloped and developing countries. As a result of these developments and changes all world societies especially developed countries have faced aging problem.

Improvement of age average of societies causes that saving rates in country economies decrease, vertical and horizontal movement in society decreases, new technology use in all sectors decreases, dependency rates increase so the pension system cost increases and the countries transfer most of the scarce sources to financing of pension system rather than effective investment and so income per capita decreases.

This study has made the analysis of economic effects of aging with annual data for 2000-2014 period in 19 developed countries consisting of USA, Canada, England, Germany, France, Spain, Italy, Austria, Portugal, Holland, Sweden, Norway, Finland, Japan, Belgium, Australia, Luxembourg, Switzerland and Denmark.

Results show clearly that the increase of age average of societies decrease LFTP and affect country economy negatively. Immediate preventions shall be taken in order to solve this problem of countries. Especially in developed country societies which are aging rapidly than the other societies, decreasing the average age level is not a problem which can be solved rapidly. Long term policies are needed in order to solve the problem.

2 Growth in income per worker.
3 Growth in LFTP.

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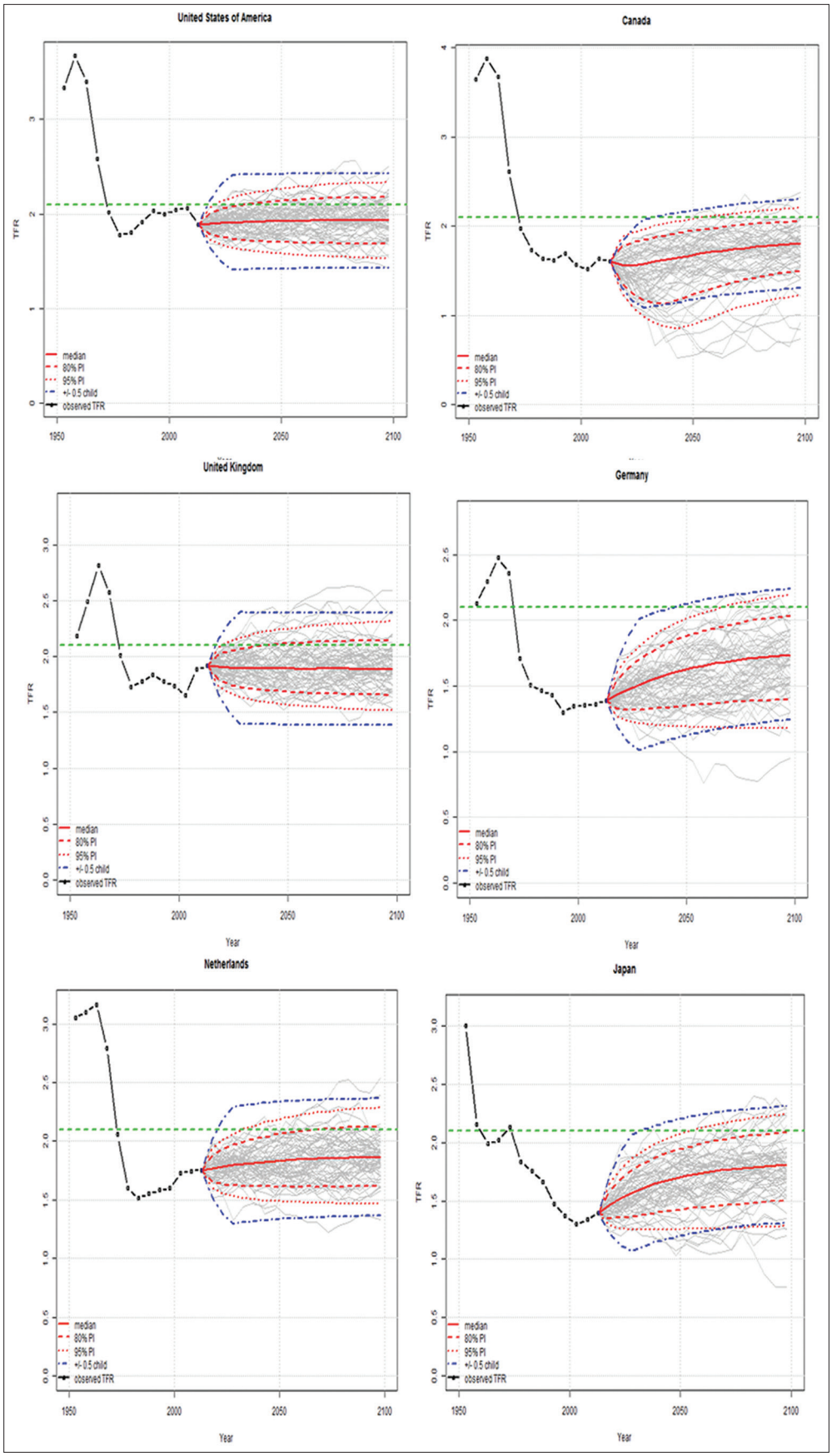
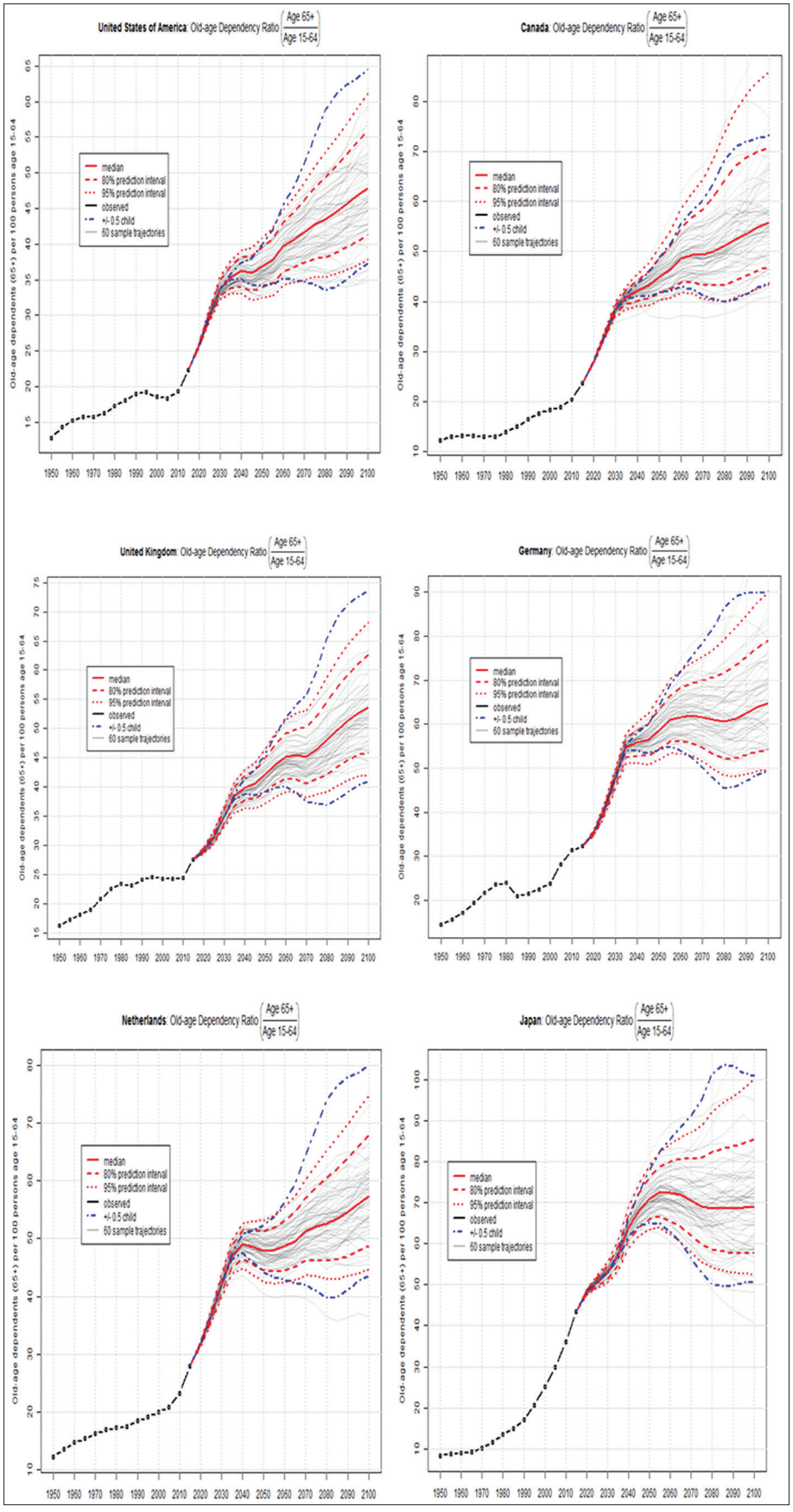
Appendix

Appendix 1: Total fertility rates



Source: UN, Department of Economic and Social Affairs, Population Division

Appendix 2: Old age dependancy ratio



Source: UN, Department of Economic and Social Affairs, Population Division

Appendix 3: Life expectancy at birth (Female)