Longevity Risk Versus Longevity Dividend

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Abstract Increased longevity means paying more for pensions, health care, and long-term care for the elderly. Many countries will be able to raise taxes enough to cover more than a fraction of the age wave's total cost. That is more important longevity risk. Most countries will have to cut old-age benefits, but the required reductions are large and are likely to meet with resistance from aging people. On the other hand we can look for longevity dividend. An older working population facing an extended retirement period has a powerful incentive to accumulate assets to support themselves. The benefits gotten from a demographic transition is neither automatic nor guaranteed. The longevity dividend occurs as the result of the productivity of older adults which depends on tax incentives, health programs, and pension and retirement policies. The main aim of this paper is to look close for determinants of the longevity risk versus longevity dividend. We apply multivariate analysis to find out the most important risk factor. After selection of the European countries to the analysis and identification risk factors that could have influence on the longevity risk and longevity dividend using PCA, we define Index of Risk of Loss Longevity Dividend. Next by building appropriate econometric models based initially on variables relating to the problems identified and at the same time determining demographic processes. We applied PCA regression to observe defined Indexes of Risk of Loss Longevity Dividend for some given scenarios.

Keywords Multivariate analysis · Longevity dividend · PCA regression

1 Introduction

Globally, people above 65 years old are the fastest-growing segments of the population and in 2019, for the first time in human history, they outnumbered children younger than 5 years old, the researchers wrote. In 2020, 9% of the global population was above 65 years old, accounting for 728 million people. This population is

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projected to increase more than twofold, reaching 1.55 billion in 2050 and accounting to 16% of the global population, at medium fertility rates (based on UN database[1]). These changes won't spread evenly across the globe. By 2050, the regions set to see the biggest increases in elderly populations include Europe, Asia, and North America, while most nations in Africa will continue to have a relatively young population.

Looking for economic and business conditions that are weakening or even reversing individuals would need to save more for retirement, retire later, or reduce consumption during retirement. Longevity dividend refers to the economic benefits of delaying the aging process and eliminating associated health care costs. The longevity dividend has been defined as "the sum of the health, social and economic benefits that result from slower ageing". The longevity dividend occurs as the result of the productivity of older adults which depends on tax incentives, health programs, and pension and retirement policies. Whether increased longevity is a burden or a dividend depends on the extent to which societies prepare for the challenges of ageing and plan to take advantage of the benefits. One of the most tangible benefits of living and working longer is the preservation of skills and knowledge. The main aim of this paper is to look close for determinants/main factors of the longevity risk versus longevity dividend. We apply multivariate analysis to find out the most important risk factor. In the empirical part we examine the impact on the longevity dividend. The paper begins by an introduction to the subject, followed by a discussion of longevity risk and longevity dividend. In the third section, we find a detailed description of the proposed methodology. The results of the research are included in the last section.

2 Longevity Risk

Now a day a global life expectancy at birth in 2019 was 73.0 years. Life expectancy at birth in the EU was 80.6 years (83.7 years for women and 78.2 years for men in 2018). In 2070, in the EU life expectancy at birth is projected to reach 86.1 years for men and it is estimated at 90.3 for women (based on the UN database[2]). Living longer affects key retirement decisions (Hunt and Blake 2015). The older generation that generally invests in the capital market, the most will move increasingly into retirement. The post-war generations will can convert their investments to cash, in order to consume more. The declining number of younger people, who tend to buy rather than save, will further reduce the demand for all kinds of investments. Longevity risk is the risk that the actual life span of individuals or whole populations will exceed expectations (Trzpiot 2016):

- Longevity risk as individuals outliving their financial resources (also called individual or idiosyncratic longevity risk),

[1] www.un.org.

[2] www.un.org.

- Longevity risk as mortality improving more than expected, or uncertainty about future mortality improvements (also called systematic, aggregate, or pooled longevity risk),
- Longevity risk as the additional cost to society or, more narrowly, a pension system, when mortality improvements are underestimated,
- Longevity risk as the adverse consequences of living a long time.

2.1 Demographic Dividend

Demographic dividend occurs when the proportion of working people in the total population is high because this indicates that more people have the potential to be productive and contribute to the growth of the economy. Due to the dividend between young and old, many argue that there is a great potential for economic gains, which has been termed the "demographic gift". A decline in fertility and mortality rates boosts working population productivity, which leads to a demographic dividend.

The demographic dividend phase refers to a multi-decade long rise in the support ratio that typically occurs during the demographic transition. For the World, the support ratio began to increase in 1974 and is projected to rise until 2025. So the first dividend phase is expected to last for 50 years based on simple averages of country values. In general, the faster the fertility decline the shorter the dividend phase (Mason et al. 2017). The average duration of the first dividend phase varies by region but for many countries, the duration is heavily dependent on projected values which are influenced by the assumed rate of change of fertility decline. The longest average duration by a wide margin is for Africa—in excess of 90 years. The next longest is in Oceania, at about 65 years, while the average duration in the Americas and Asia are very similar at a little less than 60 years. The shortest average duration, under 40 years, is found in Europe for reasons explained above, that is, Europe's estimates of the dividends are truncated and therefore, the duration and accumulated size of the dividends are underestimated (Mason et al. 2017).

2.2 Longevity Dividend

The impact of aging on the economy is a very important research area. We should confront with several interrelated issues: a decline in the working-age population, increased health care costs, unsustainable pension commitments and changing demand drivers within the economy. Firstly, a rapidly aging population means there are fewer working-age people in the economy—that means lack of a demographic dividend. This leads to a supply shortage of qualified workers, making it more difficult for businesses to fill up demand roles. For an economy that cannot fill up work demand we can expect: declining productivity, higher labour costs, lower tax revenue etc. Secondly, demand for health care will rise with age, so countries with rapidly aging populations must allocate more money and resources to their health care systems. Demographic trends and economic consequences create challenges as well as opportunities. The combination of lower tax revenue and higher spending commitments on health care, pension and other benefits is a major concern.

Changes in population age structure produce a longevity demographic dividend that depends on how the accumulation of wealth is related to population ageing. First, there are compositional effects. During the later stages of the transition to low fertility, a growing share of the population consists of individuals who are nearing the completion or who have completed their productive years. These individuals must have accumulated wealth in order to finance consumption in excess of labour income for many of their remaining years. Second, there are behavioural effects. The rise in life expectancy and the accompanying increase in the duration of retirement lead to an upward shift in the age-profile of wealth.

Maximising the opportunities associated with ageing will yield a longevity dividend that will help offset the impact of ageing on society and the economy. Increasing the ability of older people to spend money, participate in the labour market and earn income would have the following implications:

- It would directly increase overall GDP. Private spending accounts for more than 60% of aggregate demand and supports a large share of employment, while labour income is the largest component of income-based GDP (OECD 2019).
- Increase revenues from income tax and VAT payments.
- Stimulate the economy indirectly through further economic activity and expenditure generated by increased consumer demand (Oxford Economics 2016).

3 Methodology

As an objective in the research part, we attempt to identify risk factors that could have influence on the longevity dividend. An evaluation of the impact of each risk factor is presented, regardless of the longevity risk profile in the established country. We apply multivariate analysis to find out the most important risk factor. In empirical part we examine the impact on longevity dividend in the following steps:

- First step: selection of the European countries for the analysis. The cluster analysis is applied to choose representative countries from each cluster of countries due to the macroeconomic variables. Hierarchical method allows for determining the best number of clusters as well as to see the hierarchical relations between obtained groups of countries.

  Steps 2–4 are conducted for each of the selected countries.

- Second step: identification factors that could have an influence on the longevity risk/longevity dividend. Dimension reduction by Principal Component Analysis (PCA)—used for transformation of highly correlating variables (17 variables relating to the 4 areas: demography, human capital, health, labour force) into a set of uncorrelated factors, and a combination of several variables that characterize demographic changes and economic development into uncorrelated factors. (Time period: 2011–2020, data sources: OECD, Eurostat, World Development Indicators).

- Third step: we define two Index of Risk of Loss Longevity Dividend by used: Exports of goods and services (% of GDP), High-technology exports (% of manufactured exports), Income share held by lowest 20%, Merchandise trade (% of GDP) and Tax revenue (% of GDP).
- Fourth step of the research procedure was the estimation of the defined Index of Risk of Loss Longevity Dividend. The results of PCA analysis, was used to describe some risk factor, which impacts on longevity dividend. We applied PCA regression to observe defined Indexes of Risk of Loss Longevity Dividend for some given scenarios. The Index of Risk of Loss of Longevity Dividend was defined, the variability of which was estimated using principal components regression (PCR), so the estimation depends on the designated factors. Two different fixed longevity risk profiles have been proposed as the final results of the main research as particularly likely Indexes and can be considered as scenarios for the future level of longevity risk for selected countries. PCA's longevity risk factors have a significant impact on the long-term return on investment portfolios.

The main contribution is the proposed method—definition and the estimation for two Index of Risk of Loss Longevity Dividend that is sensitive to risk factors.

There are two main reasons for regressing the Index of Risk of Loss of Longevity Dividend rather to some risk factor than directly on the explanatory variables. Firstly, the explanatory variables are highly correlated (multicollinearity), especially demographic variables which may cause inaccurate estimations of the least squares regression coefficients. Secondly, the dimensionality of the regressors is reduced by taking only a subset of PCs for prediction. A method does not require uncorrelated variables or normal distribution of the residuals. Two methods, PCR and PCA, are both good techniques for dimensionality reduction in modeling data sets. There are especially useful when the independent variables are highly multicollinear (Hotelling 1933; Jolliffe 1982, 2002).

Seventeen variables relating to the areas of longevity economics discussed in the context of the longevity dividend were selected for analysis. The chosen research period was 2011–2020, and the Eurostat and World Development Indicators databases were used. In the process of identification of risk factors the following variables are taken into consideration:

1. Demographic variables describing the demographic burden in different population systems were selected:

    - Demographic dependency ratio, option 1 traditionally seen as an indicator of the level of support available for older people (population aged 0–14 and 65 or over to population aged 15–64),

- Demographic dependency ratio, option 3 traditionally seen as an indicator of the level of support available for older people (population aged 0–19 and 65 or over to population aged 20–64),
- Demographic old-age dependency ratio, option 1: new measurement of the level of support available for older people (population aged 65 or more to population aged 15–64),
- Demographic indicators, the population share of younger seniors subpopulation, percentage of the population aged 60–79,
- Demographic indicator, the share of the population of the subpopulation of all senior citizens, percentage of the population aged 60 and over,
- Demographic indicator, old-age dependency ratio, option 2 new measurement of the level of support available for older people (population aged 60 and over to population aged 20–59).

2. Then the four variables related to lifelong learning, (LLL—Long Life Learning) which supports continued employment:

   - Educational indicator, percentage of people who have basic or above basic digital skills, males, aged 25–64,
   - Educational indicator, percentage of individuals with basic or above basic general digital skills, females, aged 25–64,
   - Education indicator, lifelong learning, adult learning participation by gender, males, 25–64 years old,
   - Educational indicator, lifelong learning, adult learning participation by gender, females, 25–64 years old.

3. Then the four health-related variables, Health Life Expectancy, or HLY (Healty Life Years), which enables people to continue in employment:

   - Health indicator, health expectancy based on self-perceived health at age 65, men, in years,
   - Health indicator, health expectancy based on self-perceived health at age 65, female, in years,
   - Health indicator, health expectancy based on self-perceived health at age 50, men, in years,
   - Health indicator, health expectancy based on self-perceived health at age 65, women, in years.

4. The last group are variables related to the labour market:

   - Labour market indicator, persons in the labour market, economically active, aged 15–64,
   - Labour market indicator, persons outside the labour market, inactive, aged 15–64,
   - Labour market indicator, persons in the labour market, employed, aged 15–64.

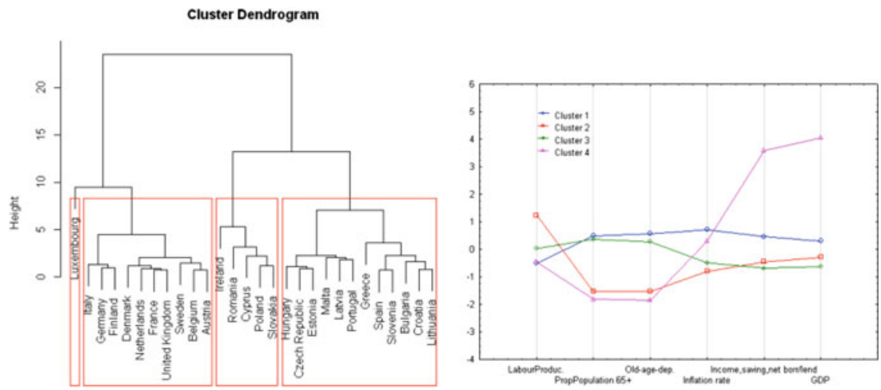

Fig. 1 Tree diagram (left) and plot of means of each cluster (right). *Source* Trzpiot and Majewska (2016)

The choice of variables was justified by substantive aspects and the availability of appropriate time series in the period that was selected for the study.[3] All variables are brought to comparability by being transformed into chain indices, i.e. we observe changes over time and we can observe the rate and direction of change on a common scale for all variables.

Relations between the above-mentioned variables and longevity are analyzed in empirical studies. Some relations are clear, while others are still a subject of debate. Due to the complexity of these relations and their multidimensionality, it is worth mentioning a few confirmed consequences of longevity (e.g. Bloom et al. 2010; Arnott and Chaves 2012; Rachel and Smith 2015; Acemoglu and Restrepo 2017; Sewdas et al. 2017): reducing investment return, reducing public saving, reducing growth rates, reducing real interest rates, affecting labor supply and returns, reallocation of saving from riskier to safe assets may lead to potential mispricing of risk, running down assets may result in negative wealth effects.

4 Impact on Longevity Dividend—Empirical Result

First step: selection of the European countries for the analysis. The cluster analysis was conducted according to the following variables: GDP growth rate (%), inflation rate (%), real productivity per hour worked, national savings, the proportion of the population aged 65 and over, old-age-dependency ratio (Ward linkage, Euclidean distance). As the result of cluster analysis (Gordon 1999), we obtain four groups of countries (Trzpiot and Majewska 2016). As the conclusion of this part of the analysis Luxembourg, as the outlier, was excluded from the analysis (Fig. 1).

[3] European Commission (DG ECFIN) and Economic Policy Committee (Ageing Working Group) (2018).

We choose one representative country from each cluster: Germany, Spain and Poland. Each of these countries represents a different level of economic growth and life expectancy. Empirical investigation of relations between longevity phenomenon and selected macroeconomic and financial variables is made for selected European countries with different levels of economic growth and life expectancy, i.e. for Germany, Spain and Poland. From a longevity perspective, life expectancy (at birth and at age 65, for both sexes) in Poland is shorter than in Germany, and Spain, while life expectancy is the highest in Spain. Spain is expected to become the world's second oldest country by 2050, behind Japan. According to the HDI index Germany—since 2010—has been in the group of five the most developed countries, Spain—in the second ten, and Poland—in the third ten the most developed countries in the world (UNDP 2018).

Second step: identification factors that could have an influence on the longevity dividend. All variables were expressed as chain indices using a base previous observation, with maintaining the strength and direction of correlation between variables, the next PCA was applied. We enumerate all variables and noticed by X1 to X17, according to the description made in methodological part.[4]

The following results were obtained for Germany: the first principal component explains 35.94% of the variance, while all components explain 85.96%, we obtained a set of linearly uncorrelated variables: The first component was identified as the risk of attendance of seniors in the labour market: X1 and X4 especially due to the high positive factor loadings of the dependency ratio and the population share of the subpopulation of younger seniors, the percentage of the population aged 60–79, also by X15 and X16. The second component (21.49% of the variation) is a set of variables reflecting the population share of the subpopulation of all seniors, the proportion of the population aged 60 and over and the proportion of employed persons (X5, X6 and X17). The next component was identified as a health risk, 18.48% of the variation. The risk factor is already the increase in age itself due to the increase in life expectancy, and an additional aspect is the assessment of health in the course of a longer life and the assessment of the possibility of remaining active in the labour market. The last component explains (10.05% of the total variance) and would be associated with educational risk and long life learning (Table 1).

In the case of Spain, five principal components explaining 93.25% of the variation were identified: the first principal component explains 33.65% of the variance. The first component reflects changes in the demographic structure of the population, the increasing dependency of seniors. The second factor is the health and education status of adults and seniors (explains 25.38% of the variance). The next component was associated with educational risk, long life learning, which explains 16.38% of the variance. The next two components relate to labour market participation, including in connection with digital skills. The last component explained 7.84% of the total variance: it is the participation of adult men in lifelong learning (Table 2).

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[4] The results was based on the classical criterion: eigenvalues are greater than 1. We noticed the loading according to the variables not less by the absolute value than 0.5 (Tables 1, 2 and 3).

Table 1 Risk factor loads of principal components: Germany

	F1	F2	F3	F4
X1	0.765			
X2	0.551			
X3	0.542			
X4	0.832			
X5		−0.7608		
X6		−0.856	0.385	
X7	0.667			
X8	−0.754			
X9				−0.645
X10				−0.676
X11			0.636	
X12	0.631			
X13	0.638			
X14	0.656			
X15	−0.848			
X16	−0.905			
X17		0.693		
Cumulative variance (%)	35.94	57.43	75.91	85.96

Source Own calculations

Same as for Spain, five principal components were identified for Poland. All components explained 91.87% of the total variance. The first component was associated with the demographic burden variables and additionally male education and female health and explained 38.16% of the variance, it was called social determinants risk. The second component was identified with an additional aspect is the assessment of health in the course of a longer life and the assessment of the possibility of remaining active in the labour market. The third component includes an indicator of the level of support available to older people—this is the risk of seniors being burdened by the labour market. The last two components explain more than 15% of the total variance: they are related to lifelong learning:—we call them the risk of not having current education—the risk of not having digital education (Tables 3 and 4).

Each of the countries selected for analysis, associated with a cluster, represents a different level of economic growth and life expectancy. The analysis of the main components for the selected countries not only allowed for the reduction of dimensions, but also enabled the identification of problems functioning in the societies of these countries selected for analysis (Table 4). In this particular analysis, income and savings variables were deliberately omitted as these aspects were analysed separately in the analysis of longevity risk.

Table 2 Risk factor loads of principal components: Spain

	F1	F2	F3	F4	F5
X1	−0.732				
X2	0.793				
X3	−0.965				
X4	−0.764				
X5	−0.971				
X6	−0.978				
X7			0.866		
X8			0.865		
X9					0.690
X10		−0.744			
X11		0.853			
X12		0.797			
X13		0.913			
X14		0.806			
X15			−0.873		
X16				0.925	
X17	0.786				
Cumulative variance (%)	33.65	59.03	75.41	85.41	93.25

Source Own calculations

Subsequently, in order to assess the impact of risk factors on the longevity dividend, the Index of Risk of Loss of Longevity Dividend was defined. For this purpose, we used information about a group of variables that have a significant impact on the level of GDP, but do not cover the classic definition and method of designation.

The variables whose change in value can be seen through a change in the share of seniors in consumption and in the labour market were identified. Weights in the above definitions were adopted arbitrarily, the dual definition will allow for verification of the impact of the identified factors on the explained variable, i.e. INDEX of the risk of loss of longevity dividend. The following variables were used:

- EXP: Exports of goods and services (% of GDP)
- TECH: High-technology exports (% of manufactured exports)
- DST: Income share held by lowest 20%
- VAL: Merchandise trade (% of GDP)
- TAX: Tax revenue (% of GDP).

Due to missing data in the databases for selected countries, two index definition formulas have been proposed. In the current situation, there are no complete observations of the DST variable for Germany and no complete data of the TAX variable for Spain.

Table 3 Risk factor loads of principal components: Poland

	F1	F2	F3	F4	F5
X1	−0.575				
X2		−0.596			
X3			0.601		
X4			0.671		
X5	0.917				
X6	0.852				
X7	−0.707				
X8					0.626
X9				0.741	
X10				0.692	
X11		0.879			
X12	−0.684				
X13		0.919			
X14		0.668			
X15			0.833		
X16	−0.911				
X17		0.493			
Cumulative variance (%)	38.16	63.29	76.65	85.48	91.87

Source Own calculations

Table 4 Longevity dividend risk factors for selected European countries (2011–2020)

	Germany	Spain	Poland
Factor 1	Risk of burden on younger seniors labour market	Risk of burdening all seniors	Risk of social conditions
Factor 2	Risk of burden on seniors labour market	Risk of loss of life in health	Risk of loss of life in health
Factor 3	Risk of loss of life in health	Risk of lack of digital education	Risk of burden on seniors labour market
Factor 4	Risk of lack of up-to-date education	Labour market risk	Risk of lack of up-to-date education
Factor 5		Risk of lack of necessary education	Risk of lack of digital education

Source Own calculations

Index of Risk of Loss Longevity Dividend, defined in two formulas, for Germany:

$$\text{INDEX\_ RLLD\_1} = 0{,}25\ \text{EXP} + 0{,}\ 25\ \text{TECH} + 0{,}25\ \text{VAL} + 0{,}25\ \text{TAX}$$
$$\text{INDEX\_ RLLD\_2} = 0{,}3\ \text{EXP} + 0{,}3\ \text{TECH} + 0{,}2\ \text{VAL} + 0{,}2\ \text{TAX}$$

whereas for Spain and Poland the definition is as follows:

$$\text{INDEX\_ RLLD\_1} = 0{,}25\ \text{EXP} + 0{,}25\ \text{TECH} + 0{,}25\ \text{DST} + 0{,}25\ \text{VAL}$$
$$\text{INDEX\_ RLLD\_2} = 0{,}3\ \text{EXP} + 0{,}3\ \text{TECH} + 0{,}2\ \text{DST} + 0{,}2\ \text{VAL}$$

Fourth step of the research procedure was the estimation of the defined Index of Risk of Loss Longevity Dividend. The variability of the Index of Risk of Loss Longevity Dividend was estimated using principal components regression (PCR), so the estimate depends on the designated risk factors written in Table 4. Based on the risk factors obtained with PCA, we proceeded to estimate the defined indices, adapting the APT theory to the model, where the sensitivity to changes in each factor is represented by a factor-specific beta coefficient (Ross 1976).

A principal components regression (PCR) analysis was then conducted, determining potential changes in the value of the defined longevity dividend loss risk indices for the countries selected for analysis. Based on risk factors received by dimension reduction (by using PCA) we started to estimate, where sensitivity to changes in each factor is represented by a factor-specific beta coefficient. All received factors are associated with risks related with longevity dividend. The results of the estimation are presented below.

Scenario # DE PCR

INDEX_ RLLD_1 = 0,005 F2 – 0,0029
$R^2 = 0.29$

The interpretation for this result for Germany is as follows: if risk represented by *F2* increase by 1 then INDEX_ RLLD_1 will increase by 0.005%.

INDEX_ RLLD_2 = 0,006 F2 – 0,0028
$R^2 = 0.33$

The interpretation for this result for Germany is as follows: if risk represented by *F2* increase by 1 then INDEX_ RLLD_2 will increase by 0.006%.

Scenario # SP PCR

INDEX_ RLLD_1 = −0,0034 F1 −0,0036 F2 + 0,0085 F4 + 0,006 F5 + 0,0029
$R^2 = 0.65$:

The interpretation for this result for Spain is as follows: if risk represented by F1 increase by 1, then INDEX_ RLLD_1 will decrease by 0.0034%, if risk represented by F2 increase by 1, then INDEX_ RLLD_1 will decrease by 0.036%, if risk represented by F4 increase by 1, then INDEX_ RLLD_1 will increase by 0.0084%, if risk represented by F5 increase by 1then INDEX_ RLLD_1 will increase by 0.006%.

INDEX_ RLLD_2 = −0,0038 F1 + 0,009 F4 + 0,0024

$R^2 = 0.41$

The interpretation for this result for Spain is as follows: if risk represented by F1 increase by 1, then INDEX_ RLLD_2 will decrease by 0.0038%, if risk represented by F4 increase by 1, then INDEX_ RLLD_2 will increase by 0.009%.

Scenario # PL PCR

INDEX_ RLLD_1 = −0,009 F1 − 0,0048 F2 + 0,0037 F3 + + 0,0029
$R^2 = 0.94$

The interpretation for this result for Poland is as follows: if risk represented by *F1* increase by 1, then INDEX_ RLLD_1 will decrease by 0.009%, if risk represented by *F2* increase by 1, then INDEX_ RLLD_1 will decrease by 0.0048%, if risk represented by *F3* increase by 1, then INDEX_ RLLD_1 will increase by 0.0037%.

INDEX_ RLLD_2 = −0,0107 F1 – 0,0046 F2 + 0,0025 F3 + 0,032

$R^2 = 0.95$

The interpretation for this result for Poland is as follows: if risk represented by *F1* increase by 1, then INDEX_ RLLD_2 will decrease by 0.0107%, if risk represented by *F4* increase by 1, then INDEX_ RLLD_2 will decrease by 0.0046%, if risk represented by *F3* increase by 1, then INDEX_ RLLD_1 will increase by 0.0025%.

The following results were obtained for Germany: in PCR model significant are the factor risk of burden on seniors in the labour market (F2). It is a set of variables reflecting the population share of the subpopulation of all seniors, the proportion of the population aged 60 and over and the proportion of employed persons. In the case of Spain, in PCR econometrics model significant were two main risk factors: the risk of burdening all seniors in the labour market (F1)—that means a dependency ratio demography, especially the increasing dependency of seniors has an important impact and general labour market risk (F4)—means people which was inactive on the labour market participation, including in connection with digital skill is relevant. For Poland in PCR model significant was three risk factors: risk of social conditions (F1) means demographic burden variables and additionally male education and female health, risk of loss of life in health and risk of burden on seniors (dependency of seniors) in the labour market has an important impact for receiving the longevity dividend. Interestingly, some factors constitute a mix of demographic and economic variables. It enables explanation of key differences between considered countries however some trends are noticeable. Countries are prepared for the challenges of population aging in very different degrees. Clustering of variables informs about diversification in both opportunities and challenges for the economy, services and society at national and local levels.

5 Conclusion

There is a statistically significant effect extracted by PCA risk factors which impact the level of defined indexes. Econometric models estimated by applied PCR are statistically significant. In Germany, we can point out one main factor connected with burden on seniors in labour market. In Spain, we have factors connecting with the labour market: risk of burdening all seniors, risk of loss of life in health and lack of digital or ever necessary education. At the end, for Poland, we receive significant factors: risk of social conditions, risk of loss of life in health and risk of burden on seniors labour market. This results based on reduction on number of variables are not in conflict with those mentioned in early empirical studies (e.g. Bloom et al. 2010; Cuaresma et al. 2014; Rachel and Smith 2015; Maestas et al. 2016; Mason et al. 2016; Acemoglu and Restrepo 2017). Rather we confirmed some projected consequences.

Longevity risk and longevity dividend appears to be very complex. From our research, we can claim that in the chosen country each of the appointed factors includes different levels of the impact of specific risk. Longevity analysis of a population or analysis of longevity economy depends on the available data and their reliability. In particular the trend sensitivity on the modeling part of the analysis. The European country moves through the "demographic transition," the slowdown in population growth and a clear shift in age structure. Longevity economy should be perceived as very important on the macro-level, we should look for the impacts of longevity on the whole economy and the environment.

Early and rapid action to reap the longevity dividend is essential. The research confirmed that waiting for the crisis to manifest itself is not an option. The factors identified weaknesses and areas for rapid response and constructive change. Many of the actions taken require very long lead times and implementation, well beyond the mandates of current decision makers. Important social and economic changes are taking place at all levels. As humanity, we are at such a point in the world's demographic development that a multifaceted approach must be implemented. For example, issues of urban planning, age-friendliness and the setting of retirement ages are national issues. And further issues such as the concept of human rights for the elderly is an international issue or migration is a bilateral and multilateral issue.

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