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# POPULATION AGING AND ECONOMIC DEPENDENCY RATIO: COMPARATIVE STUDY OF THE CZECH REPUBLIC AND SLOVAKIA

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**Abstract**

*The article examines the effects of population aging on economic dependency ratio. The results are estimated using broader definition of economic dependency allowing for variability in employment rates of age- and gender-specific groups. The Czech Republic and Slovakia are used as case study countries with similar starting point to assess their comparative population dynamics. The results suggest a significant growth of dependent share of population. Dependency ratios are predicted to increase from 110 % in 2016 to 161 % in 2060 and from 120 % to 181 % for Czech and Slovak economy respectively. Decomposition of the indicator shows substantial old-age cohort contribution, which indicates increased pressure on fiscal stability due to population aging. In second stage, the sensitivity of economic dependency on employment rates is tested to model three policy reforms to tackle the increased dependency – increase in exit age from workforce, gender equalizing labour market reform and mobilization of young-age workers. The evidence suggests that a cumulative effect of simulated reforms has the ability to decrease predicted dependency ratios back to current levels.*

**Key words:** *demographic trends; economic dependency ratio; population aging; retirement policy, social policy*

**JEL Classification:** *J11, J14, H55*

## I. INTRODUCTION

Population aging is one of the dominant socioeconomic factors of the 21st Century. As fertility rates and mortality rates in developed countries decline, the question of their future macroeconomic consequences moves to the forefront of policy makers' agendas. Will the economic dependency ratios increase to unsustainable levels? What will be the impact on labour market and fiscal stability of affected economies? The current projections of EU Aging Report (EC, 2015a) suggest that due to different trends among age-groups, the EU demographic old-age dependency ratio will increase from 27,8 % in 2015 to 50,1 % in 2060, which implies that EU would transfer from having four working-age people for every elderly person aged over 65 years to about two working-age persons (EC, 2015a, pg. 21). The following paper focuses on the demographic change in the Czech Republic and Slovakia and sets to answer two broad question a) what will be the impact of change in the population age structure on the economic dependency; and b) what are the reforms, that policy maker can use to minimize the adverse effects of the population aging and how efficient are they in terms of decreasing the economic dependency.

The results suggest a significant growth of dependent share of population in all three simulated scenarios. Dependency ratios are predicted to increase from 110 % in 2016 to 161 % in 2060 and from 120 % to 181 % for Czech and Slovak economy respectively. Decomposition of the indicator shows substantial old-age cohort contribution, which indicates increased pressure on fiscal stability due to population aging. The unemployed and young-age cohort effects vary based on the underlying assumptions. The sensitivity test of economic dependency on employment rates is conducted to evaluate efficiency of employment rate increases of age- and gender-specific cohorts. Simulation of three selected policy reforms to tackle the increased dependency – increase in exit age from workforce, gender equalizing labour market reform and mobilization of young age workers, suggests that their cumulative effect has the ability to decrease predicted dependency ratios back to 2016 levels.

The article is structured as follows. Next section provides a theoretical overview of underlying factors of population aging and its economic impact. Third section describes the methodology used to calculate the total economic dependency ratio and evaluates the data and scenarios used in the analysis. The results of the analysis are presented in two stages. Fourth section presents predictions of the total economic dependency ratio for both countries up until 2060 under three demographic scenarios – baseline, low fertility rate and low mortality rate; and evaluates the demographic effects that contribute to the overall increase in dependency ratios. Fifth section

includes the results of sensitivity test of the total economic dependency ratio on a change in employment rates of age- and gender-specific groups. Three types of policy reforms are suggested to a) quantify the impact of labour market effects on the overall dependency and b) assess their efficiency in mitigating the increase in dependency ratios due to aging. Final section concludes the analysis with a discussion of results and suggestions for further research.

## II. POPULATION AGING AND ITS ECONOMIC EFFECTS

Population aging, generally defined as a shift in the distribution of a country's population toward older ages (Weil, 2006), is primarily influenced by three major factors: fertility rates, life expectancy and net immigration. A decline in the fertility rate results in reduced number of very young, which alters the size of young age cohort and eventually, as time goes on and low birth rates persist, the size of working-age population drops. Holding other factors constant the subdued fertility rate result in higher average age of the population and may impose higher resource costs in the future. An increase in life expectancy rises the average age of the population through decreases in old-age mortality. The larger share of surviving elderly population expands the "older" tail of the population age distribution. Weil (1997) finds, that in the OECD countries over the period between 1950 and 1990, the fraction of the population that is aged over 64 rose 4,5 percentage points, from 8,3 % to 12,8 %, whereas the fraction of the population below 15 fell from 35,0 % to 27,2 %, rendering the declining fertility rate as the dominant factor contributing to population aging. In the European Union the share of elderly population (65 years old and over) on total population is expected to rise from 18,4 % in 2016 to 28,4 % in 2060, at the same time the share of children population on total population is predicted to fall from 15,6 % to 15 % (EC, 2015a). Net immigration inflows in general lessen the population aging phenomenon, since the immigrants tend to be young and of prime working age. Their differential fertility and mortality rates may further compound the anti-aging impact in the receiving country. This holds especially true in the European Union, where fertility is persistently low compared to the US, Canada and Australia (Bloom, 2016). Coleman (2009) estimates that the fertility rate of Western European countries has been elevated by 0,1 percentage points or more due to the higher average fertility of immigrants. However, the net immigration effect cannot be view as a sole remedy, since due to the predicted long-term persistence of declining fertility rates and mortality rates, the flow of immigrants necessary to ease the population aging is unfeasibly large (for more on this issue see e.g. Zlotnik (2012) or UN (2001)).

Weil (2006) postulates that "the population aging has economic effects whenever some economic interaction brings together people whose participation is a function of their age. In such situations, a change in the relative size of two age groups will require a change in behaviour by members of at least one group (Weil, 2006, pp. 2)." Similarly Sheiner, Sichel et al (2007) argue that if the generations were not linked in economic interaction, the change in the age structure of one generation would not, by definition, affect the other generation. However, since that is not the case, the intergenerational linkages have important economic impact. Due to varying degrees of economic activity, societies create frameworks by which dependent members of society are supported. In practice, there are three mechanisms by which this takes place: through their own part savings; through institutions (primarily the government) that transfers resources between unrelated people of different ages; and through their own families (Weil, 2006). The nature of these "reallocation systems" impacts the overall burden of aging population as well as the distribution of that burden (Lee, 2000).

The macroeconomic consequences of population aging are determined in part by how long individuals choose to work in the future. Lee (2012) assumes that the elderly consume at least as much as younger adults and that, as a result of the development of European style welfare state and consequential raise of pension transfers, the relative consumption by the elderly increases; at the same time, partly as a consequence of the growth in public pension programs, labour supply at older ages decreases. The consequent net result is that an older person becomes substantially more costly, as labour supply is reduced and consumption increased. This approach, however, may prove misleading as changing norms and expectations are likely to alter individual behaviour in a way that will influence the economic consequences of aging. Expectations of living longer may induce individuals to remain in workforce longer and begin to draw down savings at a later stage (Bloom, 2011).

Due to differences in saving rates and marginal propensities to consume in between the age groups, a change in age structure of population will affect main macroeconomic aggregates. Jaimovich and Siu (2009) show that changes in the age composition of workforce accounted for significant variation in volatility of business cycle observed in G7 countries. Sheiner (2014) predicts that population aging will be associated with a reduction in consumption and an increase in work effort; the extent of these adjustments will be highly related to both future and current fiscal policy. Lee (2014) argues, on the example of the United States, that population is likely to raise private asset holdings per capita and per worker; due to increasing longevity workers and retirees may be required to save more or dissave less. On the other hand the increased pressure on government budgets may also raise the public debt, rendering the net effect indeterminate. Lindbeck (2003), Gruber (2001) or Blundell, French et al (2016) provide comprehensive study of retirement incentives and their effect on labour

supply. Blundell, French et al (2016) find for many countries, that the increase in earliest age that individuals can draw benefits, people delay retirement to an often dramatically large degree. However the underling reasons for this may vary. The magnitude of the effect is, among others, dependent on the actuarial fairness of delayed retirement, rebalancing effect of lifetime wealth, individuals' constraints in borrowing and the importance of the state pension age as focal point for workforce exit. Main conclusions of Blundell, French et al (2016) suggest that indeed the supply of older workers is responsive to changes in retirement incentives, particularly lower effective tax on older workers in many countries is likely to support current trend of later retirement. Lee (2016) suggests the overall consequences of population aging to be a movement toward increased capital intensity, higher wages, lower returns on capital and a tendency to partially offset when the elderly are supported by public and private transfers rather than assets. At the same time, research conducted by Aksoy, Basso et al (2015) using panel VAR for 21 OECD countries indicate that age profile of the population has both economically and statistically significant impacts on output growth, investment and spending, estimating that demographic factors depress annual long-term GDP growth over the current decade by 0,75 % in sample countries.

The presented article draws on the previous research and develops it in two ways. Firstly, by decomposition of a broader dependency ratio, which allows for identification of cohort dynamics as well as employment effect, I quantify the contributions to the overall dependency of each age group. Secondly, by altering the parameters of employment in the broader dependency ratio, I identify and evaluate the efficiency of reforms in labour market and pension schemes.

## III. METHODOLOGY

For the following analysis I propose a broader version of economic dependency ratio, which effectively divides the population into two groups: economically active and employed and economically inactive or unemployed. This can be seen as an extension on the economic dependency ratio, defined in EC (2015a) as the share of population less employed on the employed working age population, enhanced by the age cohort diversification. A simplified TEDR equation:

$$\text{Total Economic Dependency Ratio (TEDR)} = \frac{\text{Economically Inactive}}{\text{Economically Active}}$$

To be able to distinguish the age cohort effect and employment effect, I divide population into five age cohorts differentiated by gender and impute age- and gender-specific employment rates. Hence to each of the economically active gender and age group is allocated corresponding employment rate. The final equation is shown below.

$$TEDR = \frac{\begin{array}{c} Pop^{T}_{(-14;t)} + \\ \left(1 - emp^{M}_{(15-24;t)}\right) * Pop^{M}_{(15-24;t)} + \left(1 - emp^{F}_{(15-24;t)}\right) * Pop^{F}_{(15-24;t)} + \\ \left(1 - emp^{M}_{(25-54;t)}\right) * Pop^{M}_{(25-54;t)} + \left(1 - emp^{F}_{(25-54;t)}\right) * Pop^{F}_{(25-54;t)} + \\ \left(1 - emp^{M}_{(55-64;t)}\right) * Pop^{M}_{(55-64;t)} + \left(1 - emp^{F}_{(55-64;t)}\right) * Pop^{F}_{(55-64;t)} + \\ Pop^{T}_{(65+;t)} \end{array}}{\begin{array}{c} \left(emp^{M}_{(15-24;t)}\right) * Pop^{M}_{(15-24;t)} + \left(emp^{F}_{(15-24;t)}\right) * Pop^{F}_{(15-24;t)} + \\ \left(emp^{M}_{(25-54;t)}\right) * Pop^{M}_{(25-54;t)} + \left(emp^{F}_{(25-54;t)}\right) * Pop^{F}_{(25-54;t)} + \\ \left(emp^{M}_{(55-64;t)}\right) * Pop^{M}_{(55-64;t)} + \left(emp^{F}_{(55-64;t)}\right) * Pop^{F}_{(55-64;t)} \end{array}}$$

The first age cohort ($Pop^{T}_{(-14;t)}$), representing total population younger than 14 years in year *t*, is not divided according to gender and is assumed to be economically inactive. The second ($Pop^{x}_{(15-24;t)}$), third ($Pop^{x}_{(25-54;t)}$) and fourth age cohort ($Pop^{x}_{(55-64;t)}$) are gender specific and represent number of female/male persons of ages 15-24, 25-54 and 55-64 years old respectively in year *t*. The fifth age cohort – population older than 65 ($Pop^{T}_{(65+;t)}$) - is again left undivided and assumed to be economically inactive. The employment rates $emp^{x}_{(x-x;t)}$ are calculated for each economically active, gender-specific age cohort for particular year *t*. The number of individuals of working-age and employed represents the economically active group of population and is included in the denominator of the ratio, the working-age but unemployed group enlarges the dependent share of the population and feeds into the numerator. The young-age cohort and old-age cohort are assumed to be economically inactive, hence appear only in the numerator of the TEDR. Due to the structure of the ratio the sum of the numerator and denominator compounds into the total population.

For the past population data the Eurostat database is used. The projections of population growth can be derived both from domestic as well as international sources. After tests for comparability, I have opted for the projections included in the European Commission's Aging Report published in 2015 (EC, 2015a), which uses available input data and same methodology in forming the projects for both analysed countries. The TEDR analysis uses the relevant population projection scenarios: the baseline, low fertility and low mortality. In the baseline scenario, the fertility rates are assumed to converge to that of the frontrunner-countries over the very long-term. The fertility rates of the Czech Republic and Slovakia are projected to increase over the projected period, since being classified as the Member States with very low fertility rates in 2000. However both of them are projected to remain below the natural replacement rate of 2,1 as well as all the other Member States. The projections generally assume that gains in life expectancy at birth will slow down compared with historical trends. This is because mortality rates at younger ages are already very low and future gains in life expectancy would require improvements in mortality rates at older ages (which statistically have a smaller impact on life expectancy at birth). The variation between female and male life expectancy has diminished since 1990 for all Member States due to faster improvements in life expectancy for males relative to females. Based on past trends, the net immigration inflows are projected to increase towards 2040 and decline thereafter. In the "low fertility" scenario the projected total fertility rates are lowered by 20 % all over the projections period. In the "low mortality" scenario the mortality rates are progressively reduced reaching +2 years of life expectancy towards 2070. For more details on projection assumptions see EC (2015a and 2015b). In the sensitivity analysis of TEDR to changes in employment rates the baseline scenario of population growth is assumed as reference scenario, focusing only on the impact of variation in employment rates, other scenarios are excluded.

The Eurostat employment statistics are used for the past employment rates. The projected employment rates for relevant age cohorts are taken from EC (2015a) employment rates projections. The gender-specific employment rates for relevant age cohorts are derived from projected participation rates. It is assumed that the gender distribution of employed population will follow the gender distribution of labour workforce (e.g. that the share of participating women on total workforce in a certain age cohort will equal the share of employed women on total employed in that age cohort). To project participation rates EC (2015a) uses the cohort simulation model. This methodology is particularly adapted to take into account the significant rise in the labour force participation of women over recent decades, as younger women, with a much stronger attachment to the labour force, gradually replace older women with relatively low participation rates. The participation rates are calculated by gender and single age, using average entry/exit rate in the labour force observed over the last ten years (2004-2013); applying corrective measures to model the impact of legislated pension reforms. The employment rates projections are based on the assumed increases in the exit age from the labour force due to implemented pension schemes. Mainly as a result of this process the share of older workers in total employment is projected to increase gradually. The country-specific projections of unemployment rates are assumed to converge to the non-accelerating wage rate of unemployment (NAWRU) by 2018, corresponding to the closure of the output gap. For further projections the employment rates are assumed to converge to country-specific anchors, which are the minimum/weighted median of country cycle-adjusted NAWRUs. For more details on projection assumptions of participation and employment rates see EC (2015b). The EC (2015a) assumptions for participation and employment rates are relevant only for the first part of the analysis. The sensitivity analysis relaxes these assumptions and allows for incremental changes in derived age- and gender- specific employment rates.

## IV. TOTAL ECONOMIC DEPENDENCY: DEMOGRAPHIC EFFECTS

Slovak total economic dependency (TEDR) ratio exceeded that of the Czech Republic by 9,5 percentage points in 2016, even though the Czech share of population aged 65+ and the share of population aged 14 or younger on working age population (OADR and YADR) were both higher. This initial difference is caused by relative lower Slovak total employment rate, thus higher share of economically active but unemployed population in comparison with the Czech Republic. Under the baseline scenario, as well as under other included scenarios, both of the TEDRs exhibit substantial increases over the observed period, documenting in both cases increasing share of economically dependent population. Under the baseline scenario the Czech Republic TEDR increases from 110 % in 2016 to 161 % in 2060, the Slovak TEDR increases even more (from 119 % to 180 %) moving relatively close to the 200 % threshold. The difference between the national TEDRs (from initial 9,5 pps to 19,5 pps in 2060 under the baseline scenario), suggests further worsening of the relative stance of Slovakia, however the decomposition analysis shows that underling factors in both countries differ.

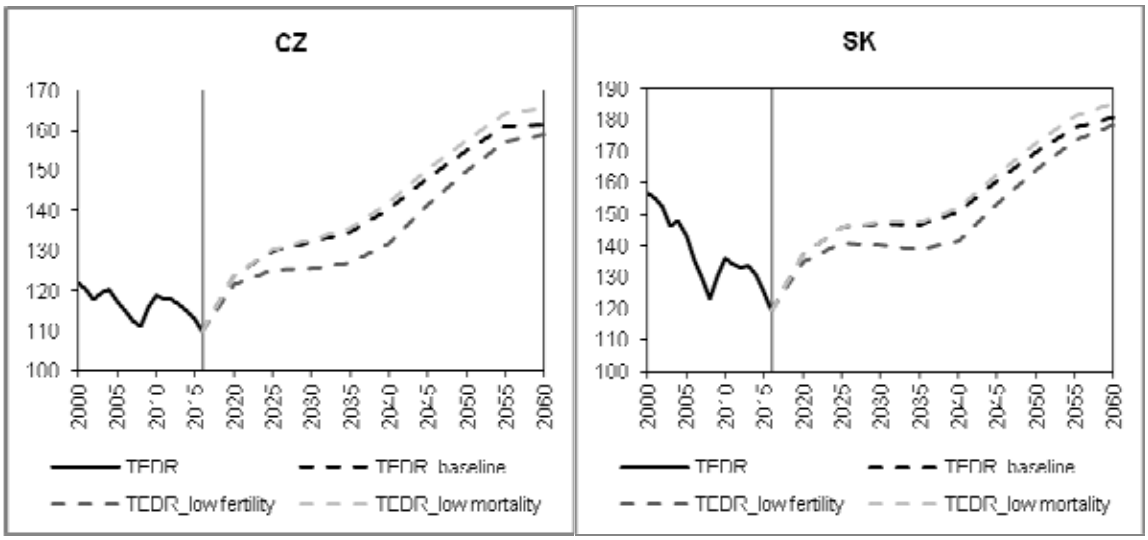


**Figure 1 – Projected Total economic dependency ratio (TEDR) in % (2000-2060)**
Source: Eurostat, author's calculation

**Table 1. –Total economic dependency ratio (TEDR) in % and selected cohort contributions in pps**

| | 2016 | baseline | | low fertility | | low mortality | |
|---|---|---|---|---|---|---|---|
| | | 2060 | pps change | 2060 | pps change | 2060 | pps change |
| CZ | | | | | | | |
| TEDR in % | 110,00 | 161,31 | 51,32 | 158,82 | 48,84 | 165,44 | 55,46 |
| *Old-age cohort contribution* | | | *41,07* | | *49,80* | | *45,31* |
| *Young-age cohort contribution* | | | *7,43* | | *-1,72* | | *7,36* |
| *Unemployed cohort contribution* | | | *2,82* | | *0,77* | | *2,79* |
| SK | | | | | | | |
| TEDR in % | 119,52 | 180,82 | 61,30 | 178,33 | 58,81 | 185,21 | 65,68 |
| *Old-age cohort contribution* | | | *58,09* | | *67,94* | | *62,62* |
| *Young age cohort contribution* | | | *6,08* | | *-3,63* | | *5,99* |
| *Unemployed cohort contribution* | | | *-2,87* | | *-5,50* | | *-2,93* |

Source: Eurostat, author's calculation

Growing old age cohorts are the dominant drivers in both countries. While the Slovak population aged 65+ is projected under the baseline scenario to more than double (+ 108,6 %) in 2060, the Czech very old age population increases by 62 %; this relative difference renders the old age cohort contributions to TEDR to be larger in case of Slovakia. As a consequence of subdued projected fertility rates the Czech and Slovak population aged 14 or younger is projected to decrease towards 2060 (3,5 % and 13 % respectively). Analogically, due to the observed difference Slovak young-age cohort contribution is rendered less significant (6,1 pps to 7,4 pps in Czech young-age cohort).

The persisting low fertility rates cause the prime age cohort of both populations to fall. The working age population is projected to shrink by 19,9 % in the Czech Republic and 27,7 % in Slovakia. As a result we see decline in both unemployed (ceteris paribus decreasing the numerator of TEDR, hence decreasing overall ratio) and employed (ceteris paribus decreasing the denominator of TEDR, hence increasing overall ratio). The resulting effect on TEDR is given by the variation in total employment rates between observed periods. In case of the Czech Republic the projected changes in age- and gender-specific employment rates together with dynamics of each cohort result in overall fall in total employment rate (from 71,8 % in 2016 to 70,4 % in 2060), which resulted in a positive contribution to TEDR (+2,82 pps). On the other hand Slovak total employment rate increased from 64,9 % to 70,4 %, causing the unemployed cohort contribution to be negative, hence decreasing the overall Slovak TEDR by 2,87 pps. The above mentioned confirm the positive impact of increase in total employment, nonetheless both countries recorded substantial increase in dependent population due to the overriding driver of population aging with relatively larger effect on TEDR.

Holding the employment rates constant projected TEDRs in both countries under the "low fertility" scenario exhibit lower values in 2060, whereas the "low mortality" scenario suggests worsening of the indicator. Lowering fertility rates cause the share of the population aged 14 or younger to decrease further relative to the base year, rendering the young-age cohort contributions to be negative. Lower fertility rates, if persistent, decrease the working-age population and consequently reduce total economically active population, effectively

reducing the number of unemployed (the unemployed cohort contributions decreased relative to the baseline scenario in both countries). Although the old age cohort contributions to TEDR increased, the increase was more than compensated by reductions in remaining contributions, thus proposing a positive impact of lowering fertility rates on total economic dependency ratio. Although above mentioned suggests a compensating effect of lower fertility rate on the economic dependency, its consequent economic impact is presumed negative. The overall populations in "low fertility scenario" decrease substantially (CZ: -1,35 mln. persons in 2060; SK -858 ths. persons in 2060), which would negatively influence the pension system of old age support. In both analysed cases the pension systems are heavily dependent on contributions of economically active population, hence the reduction in working age population may ceteris paribus cause lower contributions to PAYGO systems and pension financing issues. The "low mortality" scenario increases TEDRs of both countries; whereas the young-age and unemployed cohort contribution marginally decrease, which is caused by relative increase in total working-age population; the old-age contribution is higher relative to other scenarios. The "low mortality" scenario assumes an increased life expectancy by 2 years spread out over the projected period. When the life expectancy reaches sufficiently high level, usually by exceeding the average age that women choose to have children, its impact is more pronounced at the older tail of population distribution and causes relatively larger increases in old-age dependency than in young-age dependency as seen above.

## V. TOTAL ECONOMIC DEPENDENCY: EMPLOYMENT RATE EFFECTS

To compensate for the projected demographic shift, a policy maker may opt in for employment policy changes to reduce pressure on fiscal stability. The effect of relevant active and passive labour market policy includes both an increase in the number of economically active and employed and decrease in the share of economically active but unemployed population, hence magnifying the positive effect of employment on economic dependency. The constraints, that policy maker faces, are generally twofold. Firstly the magnitude of the impact of employment rate increase on dependency ratio varies for age- and gender-specific cohorts, hence the effectivity of policy change may differ. Secondly the initial level of employment rate of particular age group may render the policy change effect unfeasible or the targeted employment rate increase unattainable. The following sensitivity analysis quantifies the impact of selected reforms on total economic dependency ratio.

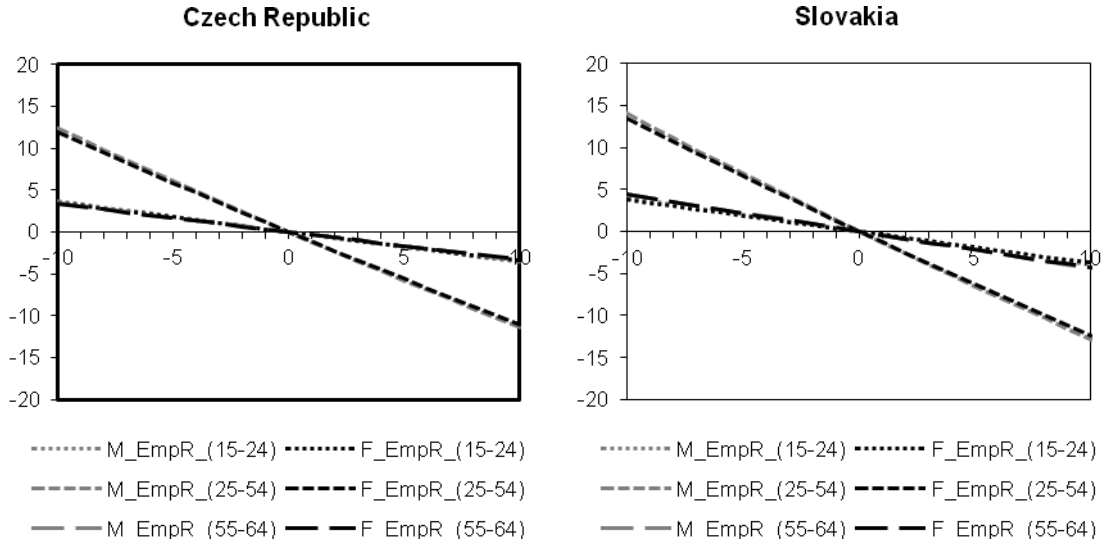


**Figure 2 – Total economic dependency ratio - employment rate sensitivity analysis**

source: Eurostat, author's calculation
Note: The graphs show sensitivity of the total economic dependency ratio to percentage points shifts in employment rates of relevant age- and gender-specific cohorts. The x-axis shows the change in employment rate in percentage points. The y-axis plots the percentage point increase or decrease relative to projected TEDR in 2060 under the baseline scenario.

The change in employment rates influences both the numerator and the denominator of TEDR, depending on the size of the age- and gender-specific cohort the effect is magnified. Fig. 2 shows the sensitivity analysis of changes in employment rate of six observed cohorts. Since the age cohort of 25 to 54 years old is the largest in both sample countries, the incremental effect of increase in employment rate is most profound. For example if the policy maker successfully increases the employment rate of both female and male population aged 25 to 54 years old by 5 percentage points, total economic dependency ratio in projected baseline scenario decreases in 2060 by 11,2 pps for the Czech Republic and 12,6 pps for Slovakia. A parallel increase in employment rate of

population aged 15-24 year olds renders only 3,5 pps and 3,8 pps decrease respectively. This would suggest that both Czech and Slovak policy maker should channel hers efforts to increase the employment in the 25-54 age groups. However to what extent is this attainable? Since the assumed employment rates are 90,2 % in case of Czech and 85,6 % in case of Slovak males, the projected hike in employment by 5 percentage points may prove unfeasible and cost-ineffective, hence the second policy maker's constraint.

To simulate the consequence of attainable labour market reforms, which are available to the policy maker, three scenarios of employment rate changes were constructed and then compared with the baseline scenario TEDR in 2060 (Results shown in Table 2.). Firstly, since some assumptions of employment rates dynamics were already included in the original TEDR calculation, a scenario ("no employment change") is included, that assumes the demographic dynamics as in baseline scenario, however keeps the employment rates of individual cohorts unchanged and equal to their respective levels in 2016. This models a situation, in which the policy maker does not respond to increasing share of older population in labour market policy. As expected the results exhibit a considerable increase in both countries TEDRs, which are mainly caused by subdued employment of the share of population age 55-64 years. The unemployed cohort contribution amount to 3,8 pps and 2,5 pps respectively, which represents considerable shift in comparison with baseline TEDR contributions in Table 1., especially in the case of Slovakia. Results show, that if there is no reaction in labour market policies, the share of dependent population is further increased by the economically active but unemployed.

**Table 2. – Total economic dependency ratio: scenario analysis**

| | 2016 | no employment rate change | | exit age increase | | younger prime = prime | | gender equality | | cumulative change | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2060 | 2060-2016 change in pp | 2060 | 2060-2060 (no emp. rate change) change in pp | 2060 | 2060-2060 (no emp. rate change) change in pp | 2060 | 2060-2060 (no emp. rate change) change in pp | 2060 | 2060-2060 (no emp. rate change) change in pp |
| Czech Republic | | | | | | | | | | | |
| TEDR in % | 110,0 | 163,2 | 53,2 | 146,2 | -17,0 | 159,5 | -3,7 | 147,6 | -15,6 | 125,9 | -37,2 |
| Old age cohort contribution | - | 80,1 | 41,6 | 74,9 | -5,2 | 79,0 | -1,1 | 75,3 | -4,8 | 68,8 | -11,3 |
| Young age cohort contribution | - | 40,0 | 7,7 | 37,4 | -2,6 | 39,5 | -0,6 | 37,6 | -2,4 | 34,4 | -5,7 |
| Unemployed cohort contribution | - | 43,1 | 3,8 | 33,8 | -9,3 | 41,1 | -2,0 | 34,6 | -8,5 | 22,8 | -20,2 |
| Slovakia | | | | | | | | | | | |
| TEDR in % | 119,5 | 193,1 | 73,5 | 166,9 | -26,2 | 187,6 | -5,5 | 176,3 | -16,7 | 144,6 | -48,5 |
| Old age cohort contribution | - | 95,4 | 63,7 | 86,9 | -8,5 | 93,7 | -1,8 | 90,0 | -5,4 | 79,7 | -15,8 |
| Young age cohort contribution | - | 40,9 | 7,3 | 37,3 | -3,7 | 40,2 | -0,8 | 38,6 | -2,3 | 34,2 | -6,8 |
| Unemployed cohort contribution | - | 56,7 | 2,5 | 42,7 | -14,0 | 53,8 | -2,9 | 47,8 | -8,9 | 30,8 | -25,9 |

Source: Eurostat, author's calculation

A standard policy response to aging population with respect to fiscal stability is to increase the effective exit age from labour force for both sexes; that is to increase the age, in which the pension schemes contributors are eligible for the state pension and leave the labour force. To simulate this, a scenario "exit age increase" sets the employment rates of 55-64 years old age cohort equal to those of 25-54 year olds, which are assumed to be in their prime working age, hence at the highest levels of employment attainable. The higher impact in case of Slovakia is explained by a larger share of 55-64 old years on working age population relative to that of the Czech Republic, due to the faster population aging dynamics. Therefore the demographic shift presents both greater challenge and greater opportunity for the Slovak fiscal stability. In a situation, in which unemployment rates of older prime cohort remain similar as in 2016, the fiscal stability would be confronted with both higher old-age dependents and unemployed dependents with lower economically active and employed population base to finance the fiscal expenditures. On the other hand, if the older prime population is successfully incorporated into the labour market, the fiscal pressure reduces and furthermore improves the Slovak fiscal stance due to the higher taxes revenues from labour. The resulting decreases in TEDR (26,2 pps for Slovakia and 17 pps for the Czech Republic) compared to the "no employment change" scenario therefore suggest large space for fiscal improvement due to the population aging in case of Slovakia and to the lesser extent in the Czech Republic.

The policy maker may also choose to target the employment rate of the younger age cohort (15-24 year olds). The younger prime age group consists of a share of 15-18 year olds who usually only occasionally participate on labour force through part-time or seasonal jobs; the second portion - 18-24 year olds – are differentiated according to their pursued level of education. Due to these effects, the younger prime age cohort exhibits usually relatively low employment rate. To simulate the effect of activation of younger prime age cohort, the third scenario sets both male and female employment rates equal to the highest past levels of

employment rate of younger prime age cohorts in respective countries, since those can be perceived as probable even tough elevated with respect to overall low unemployment in 2016. The scenario exhibits positive however subdued effect on both TEDRs (-5,5 pps for Slovakia and -3,7 pps for the Czech Republic). Once more we see larger impact in case of Slovak TEDR, due to the relative larger share of young prime age population on total prime age population. The impact even though lower compared to other policy changes, may be viewed as an additional positive contribution to complex employment policy change.

Finally the policy maker can choose to improve the gender equality in labour market, tapping into the pool of female age groups with lower employment rates relative to men. The inequality in gender-specific employment rates is usually a result of the prevalence and longitude of materiality leave, hence lower overall participation rate of women on labour force. The "gender-equality" scenario models this option by setting the employment rates of the prime female working-age cohorts equal to men based on the levels of 2016. The resulting decreases of TEDR exhibit the largest improvement in terms of dependency, increasing both the numerator and the denominator of the ratios. Due to the larger male-female employment rate difference in Slovakia, we see the larger effect in Slovak TEDR.

Combining the three labour market policy effects result in substantial decrease in both country's economic dependency ratios. The cumulative effect decreases share of Czech dependent population by 37,2 pps and renders the predicted total dependency ratio at 125,9 %. In case of Slovakia the effect is even larger, with resulting reduction of 48,5 pps. Not only the share of unemployed cohort on TEDR decreases (from 43,1 % to 22,8 % in case of the Czech Republic, and from 56,7 % to 30,8 % in Slovakia) but the consequential increase in working age population decreases the old-age and young-age cohort contributions. In other words, even though the old and young dependent population increase in absolute terms, a successfully implemented labour market policy has the ability to compensate the pressure on fiscal expenditures in pensions and social welfare through larger workforce. Even though the projected population aging is larger in case of Slovakia, the potential impact of labour market reforms is greater. In fact the combined labour market reform lowers Slovak total economic dependency ratio to 144,6 %, which is lower than its respective levels in 2000-2004, hence it has the ability to keep the total economic dependency ratio from increasing above current levels entirely.

## VI. CONCLUSION

The results show a substantial increase in dependency ratios of both analysed countries compared to 2016 levels. Whereas a decrease in fertility rates to some extent reduces predicted dependency ratios in relation to baseline increase, both countries as a result experience significant decline in total population, thus rendering the scenario from the point of overall fiscal stability rather problematic. A reduction of mortality rates result in higher predicted dependency ratio, since the demographic gains from the increase life expectancy are realized at the older age cohorts rather than the younger ones. In second stage the results show that a successful implementation of policy that either increases exit age from workforce, increases employment rate of younger age cohort, or minimizes the spread between male and female employment rate, has a positive effect on predicted dependency ratio. A cumulative effect of the three suggested policy changes has the ability to decrease predicted TEDRs to levels comparable to those of 2016.

The results are in line with previous research of Dolls, Doorley et al (2015), who used a microsimulation model and included partial equilibrium treatment of the labour market to project demographic change in 27 European countries and assessed the impact of 5 year increases in the statutory retirement age. They found that if the policy change of increase in retirement age is factored in, the adverse fiscal impact of demographic shift is removed completely. However the suggested policy change should be implemented in context of greater labour market reform. As Boersch-Supan, Hartl et al (2014) argued, a sole mobilization of the employment pool may not resolve all aging related issues. They showed that those policy proposals aim only at the extensive margin of labour supply and abstract from further consideration of change in behaviour of working age cohorts on the intensive margin.

Hence the suggested research avenues include especially those, which simulate labour market in equilibrating model and include both the internal as well as exogenous changes. From this point of view, the results of presented paper may serve as a rule of thumb for policy makers in implementing a certain policy change as well as sound basis for evaluation of change in aggregate macroeconomic indicators such as consumption or wealth accumulation.

# APPENDIX A

**Assumptions: employment rate effect**

| Czech Republic | base year | prediction (demographic scenario) | | | | | | | | | assumption (no employment change) | assumption (exit age increase) | assumption (younger primer=prime) | assumption (gender equality) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indicator/Year | 2016 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 | 2060 | 2060 | 2060 | 2060 |
| employment rate_female_(15-24) in % | 23,2 | 19,9 | 18,8 | 20,9 | 20,6 | 20,6 | 20,7 | 20,6 | 20,4 | 20,2 | 23,2 | 23,2 | 33,8 | 23,2 |
| employment rate_female_(25-54) in % | 78,4 | 77,3 | 77,3 | 77,1 | 77,3 | 77,6 | 77,3 | 77,3 | 76,9 | 76,6 | 78,4 | 78,4 | 78,4 | 92,7 |
| employment rate_female_(55-64) in % | 49,3 | 45,4 | 49,6 | 55,3 | 56,1 | 57,2 | 62,5 | 64,0 | 65,8 | 71,4 | 49,3 | 78,4 | 49,3 | 49,3 |
| employment rate_male_(15-24) in % | 33,8 | 28,0 | 26,5 | 29,5 | 28,8 | 28,9 | 29,1 | 28,9 | 28,6 | 28,4 | 33,8 | 33,8 | 33,8 | 33,8 |
| employment rate_male_(25-54) in % | 92,7 | 89,9 | 89,7 | 89,7 | 90,8 | 92,1 | 92,3 | 92,0 | 90,8 | 90,2 | 92,7 | 92,7 | 92,7 | 92,7 |
| employment rate_male_(55-64) in % | 68,2 | 64,4 | 67,0 | 70,1 | 69,2 | 66,9 | 68,1 | 67,9 | 69,9 | 75,7 | 68,2 | 92,7 | 68,2 | 68,2 |
| Slovakia | base year | prediction (demographic scenario) | | | | | | | | | assumption (no employment change) | assumption (exit age increase) | assumption (younger primer=prime) | assumption (gender equality) |
| Indicator/Year | 2016 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 | 2060 | 2060 | 2060 | 2060 |
| employment rate_female_(15-24) in % | 18,2 | 15,9 | 14,6 | 16,1 | 17,5 | 17,3 | 17,0 | 16,7 | 16,4 | 16,5 | 18,2 | 18,2 | 31,9 | 18,2 |
| employment rate_female_(25-54) in % | 73,5 | 68,5 | 67,2 | 67,4 | 68,0 | 68,5 | 67,9 | 68,1 | 68,1 | 67,9 | 73,5 | 73,5 | 73,5 | 86,3 |
| employment rate_female_(55-64) in % | 43,5 | 44,8 | 49,8 | 54,5 | 55,8 | 56,1 | 58,5 | 59,8 | 62,2 | 67,3 | 43,5 | 73,5 | 43,5 | 43,5 |
| employment rate_male_(15-24) in % | 31,9 | 25,6 | 23,6 | 26,0 | 28,1 | 27,9 | 27,4 | 26,8 | 26,4 | 26,5 | 31,9 | 31,9 | 31,9 | 31,9 |
| employment rate_male_(25-54) in % | 86,3 | 82,3 | 81,7 | 82,9 | 84,6 | 86,1 | 86,3 | 86,4 | 86,2 | 85,6 | 86,3 | 86,3 | 86,3 | 86,3 |
| employment rate_male_(55-64) in % | 55,1 | 52,8 | 54,5 | 59,1 | 62,6 | 64,8 | 67,4 | 69,6 | 73,0 | 78,7 | 55,1 | 86,3 | 55,1 | 55,1 |

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## VIII. REFERENCES

1. Aksoy, Yunus, Henrique S Basso, Ron P Smith and Tobias Grasl. (2015) Demographic structure and macroeconomic trends, Working Paper 1528, Banco de España: 1–68.
2. Borsch-Supan, Axel, Klaus Hartl, and Alexander Ludwig. (2014) Aging in Europe:Reforms, International Diversification and Behavioral Reactions, The American Economic Review 104: 1–7.
3. Bloom, David E, David Canning, and Gunther Fisk. (2011) Implications of Population Aging For Economic Growth, Working Paper 16705, NBER Working Paper Series: 1–38.
4. Bloom, D. E., and D. L. Luca. (2016) The Global Demography of Aging: Facts, Explanations, Future, Handbook of the Economics of Population Aging Vol. 1A, pg. 3–56, 1st ed. Elsevier B.V.
5. Blundell, R, E French, and G Tetlow. (2016) Retirement Incentives and Labor Supply, Handbook of the Economics of Population Aging Vol. 1A, pg. 457–566, 1st ed. Elsevier B.V.
6. Coleman, David. (2009) The demographic effects of international migration in Europe, Oxford Review of Economic Policy 24(3): 452–476.
7. Dolls, M., Doorley, K., Paulus, A., Schneider, H., Siegloch, S., Sommer, E., (2015) Fiscal sustainability and demographic change: a micro approach for 27 EU countries, IZA DP No. 9618 (December).
8. European Commission. (2015a) The 2015 Ageing Report: Economic and budgetary projections for the 28 EU Member States (2013-2060), European Commission Economic and Financial Affairs European Economy Main series, 1–424.
9. European Commission. (2015b) The 2015 Ageing Report: Underlying Assumptions and Projection Methodologies, European Commission Economic and Financial Affairs European Economy Main series, 1–436.
10. Gruber, Jonathan, and David Wise. (2001) An International Perspective on Policies For an Aging Society, Working Paper 8103, NBER Working Paper Series: 1–34.
11. Jaimovich, Nir, and Henry E Siu. (2009) The Young, the Old, and the Restless: Demographics and Business Cycle Volatility, The American Economic Review 99(3): 1–24.
12. Lee, Ronald. (2000) A Cross-Cultural Perspective on Intergenerational Transfers and the Economic Life Cycle, in Andrew Mason and Georges Tapinos, eds., Sharing the Wealth: Demographic Change and Economic Transfers between Generations, Oxford: Oxford University Press, 2000, pp.17-56.
13. Lee, Ronald. (2012) Macroeconomic Implications of Demographic Changes: A Global Perspective, Institute for Monetary and Economic Studies, Bank of Japan: 1–24.
14. Lee, Ronald D. (2014) Macroeconomic Consequences of Population Aging in the United States: Overview of a National Academy Report, The American Economic Review 104(5): 234–239.
15. Lee, Ronald. (2016) Macroeconomics, Aging, and Growth, Handbook of the Economics of Population Aging 59–118, 1st ed. Elsevier B.V.
16. Lindbeck, Assar, and Mats Persson. (2003) The Gains from Pension Reform, Journal of Economic Literature 441: 1–40.
17. Sheiner, L., Sichel, D., Slifman, L., (2007) A primer on the macroeconomic implications of population aging, In: Staff Working Papers in the Finance and Economics Discussion Series (FEDS) 2007–01.
18. Sheiner, Louise M. (2014) The Determinants of the Macroeconomic Implications of Aging, The American Economic Review 104(5): 218–223.
19. United Nations. (2001) Replacement migration: is it a solution to declining and ageing population?, Executive summary. United Nations Population Division.
20. Weil, David N. (1997) The Economics of Population Aging, Handbook of Population and Family Economics, Edited by M.R. Rosenzweig, and O. Stark, Vol. 1B, 968-1010, 1st ed. Elsevier B.V.
21. Weil, David N. (2006) Population Aging, NBER Working paper 12147, NBER Working Paper Series: 1–21.
22. Zlotnik, H. (2012) International migration and population ageing, In: Beard, J.R., Biggs, S., Bloom, D.E., Fried, L.P., Hogan, P., Kalache, A., Olshansky, S.J. (Eds.), Global Population Ageing: Peril or Promise. World Economic Forum, 2011, Geneva, pp. 97–102 (Chapter 20).