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# **Demographic Dividend & Economic Development in Eastern and Central European Countries:**

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**Note:** I certify I have the right to publish with the MPRA

## **Abstract:**

The following paper discusses the occurrence of the demographic dividend in Eastern and Central European countries (ECE). The data used is extracted from the World Bank and provides with descriptive statistics in addition to empirical analyses of fertility and mortality rates, and the significant causal links between the change in the demographic composition and unemployment, economic development, expenditure, education, and female participation variables. This is throughout regression analysis process with robust standard error and Granger causality tests. Empirical findings indicate that both the fertility rates and mortality rates of infants have decreasing trends in these countries. Further analysis indicates that the demographic dividend already occurred in these countries and has ended except for Estonia, Hungary and Romania. The last part of the results indicates that the change of the demographic composition of the populations of ECE countries have causalities that differ from an economy to another.

**Keywords:** Demographic Dividend, Demographic Transition, ECE Countries, Granger Causality

**JEL:** J11-J13-O11

## **Introduction:**

Changes in population ageing and population composition operates in Eastern and Central European (ECE) countries within different periods and different geographical locations (Gløersen, Drăgulin, & Hans, 2016). The rapid demographic changes occurred during this previous 50 years (European Commission, 2014) and resulted in the decrease of the working age ratio in all ECE countries. The demographic transition is characterized by declining fertility rates and depopulation in rural areas (Aabrenn, 1989).

Policy makers in ECE countries are reforming their policies with regard to territorial development besides scaling down public services (European Parliament, 2008). Other discussed policies that are directly linked to the change of the demographic transition concern over-concentration in some geographic locations, intra and extra-European migration, etc. (Barca, 2009; OECD, 2006; European Commission, 2011; European Parliament, 2010).

This paper is a follow up to the contribution of Harkat and Driouchi (2017), and aims at studying the demographic dividend in ECE countries. The demographic dividend is the window of economic opportunity that results from declining fertility rates and declining mortality rates, as more resources are allocated for the working age population.

The focus of this study is to estimate the demographic dividend and the periods of its occurrence of each ECE country in addition to the analyses of the impacts of the dependency ratio, which represent the population change with focus on the working age population, on economic, social, and educational variables.

Research questions that can be raised at this stage are:

- Does ECE countries have significant decreasing trends of fertility and mortality?
- Which countries are still under the demographic dividend period?
- What are the impact of the change in the population ageing on social, economic, and educational variables?

- Did the population change affect significantly females' participation in education?

This paper introduces a brief literature review of the demographic dividend followed by the theoretical framework. This is followed by the data & method section, results section, and conclusion & discussion.

### **Literature Review:**

In the early to mid-20<sup>th</sup> century, the Eastern and Central European countries have been moving throughout a significant population transition (Chawla, Betcherman & Banerji, 2007), but until nowadays, there are only few contributions that analyzes the impact of the fertility rate (Caldwell & Schindlmayr, 2003).

The contribution of Bloom, Canning, and Sevilla (2003) provides with a model that studies the interrelationship between the demographic change, or the demographic transition as a dependent variable, and economic growth, that is represented by the GDP per capita. Other studies analyzes the determinants that lead to the demographic transition (Hobcraft, 1996; Lesthaeghe, 1989). In the case of Cameroon, it is the economic crisis that led to the decline in fertility rate (Eloundou-Enyegue, Stokes & Cornwell, 2000). The economic crisis in the US that occurred in the 1970s also encourages the personal attitude of low-fertility (Teitelbaum & Winter, 1985).

The effect of the demographic change on social and economic variables in ECE countries has been subject to the interest of many researchers (Holzer & Kowalska, 1997; Kamaras, 1999; Philipov, 2001; Rychtarikova & Kraus, 2001; Caldwell & Schindlmayr, 2003; Standing, 1996; Witte & Wagner, 1995). ECE economies do not show any evidence of long or prolonged economic crisis that led to the demographic change, except for some few countries (Madison, 2001; Eurostat, 2004).

The contribution of Hoff (2008) describes the main drivers of the population ageing change that are mortality, fertility, and migration in ECE countries. According to Eurostat data, the life expectance in European Union (EU) has increased in the period between 1960 and 2004 from 67 to 77 for males. But in some countries such as Czech Republic, Bulgaria, and Slovakia, the life expectancy is only 68 years. In other EU countries such as Russia, life expectancy decreased because of unhealthy lifestyles

(Bloom, Canning & Sevilla, 2003; Leon et al., 1997; Shkolnikov & Valin, 1995; Walberg et al., 1998).

With regard to fertility rates among ECE countries, Hoff (2006), Fratzak (2004), and Chesnais (1992) indicates that their trends are decreasing for all these economies. These contributions also indicate that starting 1960s, all ECE countries started having significant shares of older people in their societies.

Further analysis should be on the first and second demographic dividend in ECE. This will enable to these economies to identify the window of opportunity and adapt them to make policies and reforms to benefit youth employment and economic development.

### **Theoretical Framework:**

Kirk (1996) first introduced the demographic transition theory that is characterized by the transition from higher rates of fertility and mortality to lower ones (Lee, 2003; Davis, 1963). This demographic shift leads to an accelerated economic growth, mainly because of the increase of the active population, and the decrease of the dependents, that are either the youngest segment between 0 and 14 years old, or the oldest segment that are over the age of 65 (Gribble & Bremner, 2012).

This is defined as the demographic dividend or the window of opportunity of economies, as there is more labor supply, and resources are targeting the working age segment (Bloom et al., 2002).

This contribution is a follow up to the research of Harkat and Driouchi (2017).

The current paper borrowed the model of Barro and Sala-i-Martin (1995; 2004) to analyze the link between the income per capita and economic growth, and apply it to estimate the demographic dividend. This model is used in many contributions (Mody & Aiyar, 2011; Bloom & Canning, 2004; Harkat & Driouchi, 2017).

The demographic dividend is estimated by analyzing the link between the income per capita with emphasis on the working age segment, and is given by the following model:

$$DD_t = \beta_1(\ln(w_t) - \ln(w_0)) + \beta_2(g(w_t))$$

In the formula above, the  $DD_t$  represents the demographic dividend at period t,  $w_t$  represent the working age ratio, which is the working population over the dependent population, at time t, and  $w_0$  represent the initial working age ratio, which is based on the year of 1960.

With regard to the coefficients  $\beta_1$  and  $\beta_2$ , they are derived from the robust standard error regression between the GDP growth as independent variable, and GDP per capita, log working age ratio, and log initial working age ratio, as dependent variables.

## Empirical Investigation

### 1. Data and methods:

The results in this contribution are divided into three sections. The first part analyzes the trends of the fertility rate and the mortality per 1000 infants. These trends are analyzed using regression models that are:

$$Y_i = \alpha + \beta_1 F_i + \varepsilon$$

$$Y_i = \alpha + \beta_1 M_i + \varepsilon$$

Where:

$Y$ : is the independent variable, which represents years,

$\alpha$ : the intercept,

$\beta$ : the coefficient that corresponds to each variable,

$F_i$ : fertility rate at year i,

$M_i$ : mortality rate at year i,

$\varepsilon$ : standard error.

Concerning the second part, it estimates the demographic dividend using a heteroskedasticity-robust standard error regression process to derive the coefficients of the log initial working age ratio and the growth of the working age ratio. This regression process is given by the following model:

$$GDPgrowth_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon$$

Where:

$Y_i$ : is the independent variable, which represents the GDP growth,

$\alpha$ : the intercept,

$\beta$ : the coefficient that corresponds to each variable,  
 $X_{1i}$ : log (GDP per capita) at year  $i$ ,  
 $X_{2i}$ : log (initial working age ratio) at year  $i$ ,  
 $X_{3i}$ : growth of initial working age ratio at year  $i$ ,  
 $\varepsilon$ : standard error.

The last part of the results indicates the causal links between the dependency ratio, that represent the change in the demographic composition with focus on the population age 15-65, and unemployment, economic development, expenditure, education, and female participation in education variables.

With regard to the unemployment variables, they are composed of: total labor force, male labor force, total unemployment, male unemployment, female unemployment, and youth participation in the labor force. For the economic development variables, they are GDP per capita, GDP per capita growth, gross savings, industry value added, and agriculture value added. Concerning the expenditure variables, they are expenditure on education, expenditure per capita on health, expenditure on health, expenditure on private health, and expenditure on public health. For the education variables, they are enrolment in primary education, enrolment in secondary education, enrolment in secondary vocational education, and enrolment in secondary general education. Finally, and for the female participation in education, it expresses the percentage of females in each educational level that are primary, secondary, secondary general, and secondary vocational.

The hypotheses tested are those of the contribution of Harkat and Driouchi (2017), and are summarized bellow:

1. Granger causality between dependency ratio and employment variables:
  - $H_0$ : Total labor force does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause total labor force.
  - $H_0$ : Female labor force does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause female labor force.
  - $H_0$ : Total unemployment does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause total unemployment.
  - $H_0$ : Young female unemployment does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause young female unemployment.
  - $H_0$ : Young male unemployment does not Granger cause dependency ratio.

$H_A$ : Dependency ratio does not Granger cause young male unemployment.

- $H_0$ : Youth labor force participation does not Granger cause dependency ratio.

$H_A$ : Dependency ratio does not Granger cause youth labor force participation.

2. Granger causality between dependency ratio and economic development variables:

- $H_0$ : GDP per capita does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause GDP per capita.
- $H_0$ : GDP per capita growth does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause GDP per capita growth.
- $H_0$ : Gross savings does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause gross savings.
- $H_0$ : Agriculture value added does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause agriculture value added.
- $H_0$ : Industry value added does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause industry value added.

3. Granger causality between dependency ratio and expenditure variables:

- $H_0$ : Education expenditure does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause education expenditure.
- $H_0$ : Health expenditure per capita does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause health expenditure per capita.
- $H_0$ : Private health expenditure per capita does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause private health expenditure per capita.
- $H_0$ : Public health expenditure per capita does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause public health expenditure per capita.
- $H_0$ : Total health expenditure does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause total health expenditure.

4. Granger causality between dependency ratio and educational variables:

- $H_0$ : Enrolment in primary education does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause enrolment in primary education.



- $H_0$ : Enrolment in secondary education does not Granger cause enrolment in secondary education.  
 $H_A$ : Dependency ratio does not Granger cause enrolment in secondary education.
  - $H_0$ : Enrolment in secondary vocational education does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause enrolment in secondary vocational education.
  - $H_0$ : Enrolment in secondary general education does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause enrolment in secondary general education.
5. Granger causality between dependency ratio and female participation in education variables:
- $H_0$ : Female enrolment in primary education does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause female enrolment in primary education.
  - $H_0$ : Female enrolment in secondary education does not Granger cause enrolment in secondary education.  
 $H_A$ : Dependency ratio does not Granger cause female enrolment in secondary education.
  - $H_0$ : Female enrolment in secondary vocational education does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause female enrolment in secondary vocational education.
  - $H_0$ : Female enrolment in secondary general education does not Granger cause dependency ratio.  
 $H_A$ : Dependency ratio does not Granger cause female enrolment in secondary general education.

The data used is extracted from the World Bank and are of the period between 1960 and 2016. The selected ECE countries are: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia.

## **Results:**

- I. Trends of fertility and mortality rates in ECE countries:
  1. **Fertility rates in ECE countries**

The analysis of fertility rate in ECE countries indicates that all these countries have significant decreasing trends. The coefficients range from a value of -0.034 to a value of -0.013.

**Table 1: Trend of fertility rate in ECE countries**

| Country                | R-squared | Intercept         | Fertility Rate      |
|------------------------|-----------|-------------------|---------------------|
| <b>Bulgaria</b>        | 0.703     | 2.337<br>(41.636) | -0.019<br>(-11.303) |
| <b>Croatia</b>         | 0.875     | 2.225<br>(82.000) | -0.017<br>(-19.444) |
| <b>Czech Republic</b>  | 0.635     | 2.319<br>(35.501) | -0.019<br>(-9.683)  |
| <b>Estonia</b>         | 0.455     | 2.166<br>(35.684) | -0.013<br>(-6.712)  |
| <b>Hungary</b>         | 0.704     | 2.143<br>(47.489) | -0.016<br>(-11.346) |
| <b>Latvia</b>          | 0.432     | 2.048<br>(32.528) | -0.013<br>(-6.406)  |
| <b>Lithuania</b>       | 0.816     | 2.480<br>(55.755) | -0.022<br>(-15.483) |
| <b>Poland</b>          | 0.872     | 2.729<br>(57.309) | -0.029<br>(-19.163) |
| <b>Romania</b>         | 0.545     | 2.740<br>(25.089) | -0.028<br>(-8.044)  |
| <b>Slovak Republic</b> | 0.905     | 2.938<br>(61.828) | -0.034<br>(-22.734) |

## 2. Mortality rates in ECE countries

Concerning the mortality rate per 1000 live births, regression analysis indicates that all ECE countries have significant decreasing trends.

**Table 2: Trend of mortality of infants (per 1000 infants) in ECE countries**

| Country         | R-squared | Intercept          | Mortality per 1000 live births |
|-----------------|-----------|--------------------|--------------------------------|
| <b>Bulgaria</b> | 0.923     | 38.414<br>(51.105) | -0.563<br>(-24.546)            |
| <b>Croatia</b>  | 0.914     | 25.181<br>(28.136) | -0.426<br>(-18.708)            |

|                        |       |                    |                     |
|------------------------|-------|--------------------|---------------------|
| <b>Czech Republic</b>  | 0.945 | 25.577<br>(34.111) | -0.454<br>(-23.802) |
| <b>Estonia</b>         | 0.989 | 34.412<br>(79.445) | -0.617<br>(-55.447) |
| <b>Hungary</b>         | 0.946 | 46.706<br>(50.736) | -0.887<br>(-30.752) |
| <b>Latvia</b>          | 0.768 | 27.817<br>(21.428) | -0.363<br>(-10.777) |
| <b>Lithuania</b>       | 0.958 | 25.587<br>(62.668) | -0.393<br>(-32.775) |
| <b>Poland</b>          | 0.891 | 41.442<br>(34.230) | -0.796<br>(-20.981) |
| <b>Romania</b>         | 0.926 | 59.061<br>(44.343) | -0.932<br>(-24.080) |
| <b>Slovak Republic</b> | 0.953 | 30.903<br>(41.559) | -0.489<br>(-25.882) |

## II. Demographic dividend results in ECE countries:

The coefficients summarized in Table 3 are the result of the robust standard error regression process of the GDP growth as an independent variable, and log GDP per capita, log initial working age ratio, and growth rate of working age ratio as dependent variables. The two latter coefficients are the basis for the estimation of the demographic dividend.

**Table 3: Coefficients obtained from the robust standard error regression analysis for ECE countries**

| <b>Country</b>        | <b>Intercept</b> | <b>Log GDP per capita</b> | <b>Log initial working age ratio</b> | <b>Growth rate of working age ratio</b> |
|-----------------------|------------------|---------------------------|--------------------------------------|---|
| <b>Bulgaria</b>       | -1.293           | 11.643                    | -19.750                              | 7.443                                   |
| <b>Croatia</b>        | 321.990          | -11.924                   | -148.529                             | 6.534                                   |
| <b>Czech Republic</b> | 206.264          | 24.549                    | -164.702                             | 9.357                                   |
| <b>Estonia</b>        | -113.989         | -10.146                   | 86.948                               | -1.639                                  |
| <b>Hungary</b>        | -698.659         | -11.205                   | 406.216                              | -4.495                                  |
| <b>Latvia</b>         | -210.836         | -5.774                    | 130.551                              | 0.575                                   |
| <b>Lithuania</b>      | 492.744          | 1.324                     | -269.812                             | 3.068                                   |
| <b>Poland</b>         | 468.718          | 22.612                    | -300.970                             | 6.518                                   |
| <b>Romania</b>        | -667.520         | 8.813                     | 348.347                              | 10.950                                  |
| <b>Slovakia</b>       | 431.448          | 25.396                    | -287.844                             | 7.279                                   |

Table 4 summarizes the estimation of the demographic dividend in ECE countries for the period between 1965 and 2015 per each 5 years. Results indicate that demographic dividend no longer exist in ECE countries, except for Estonia, Hungary, and Romania. In Hungary, the demographic dividend started in 1995, and still has an increasing trend. In Estonia, the demographic dividend started in 2005. But for Romania, the demographic dividend started in 1985, and even if it is still occurring, it has a decreasing trend.

**Table 4: The demographic dividend in ECE countries**

| Country               | 1965  | 1970  | 1975  | 1980   | 1985   | 1990  | 1995  | 2000   | 2005   | 2010   | 2015   |
|-----------------------|-------|-------|-------|--------|--------|-------|-------|--------|--------|--------|--------|
| <b>Bulgaria</b>       | 1.88  | -0.42 | -1.97 | 0.23   | 1.27   | -0.03 | 1.64  | 2.50   | 2.36   | -3.14  | -5.99  |
| <b>Croatia</b>        | 1.81  | -0.19 | -1.93 | -0.61  | -0.87  | -2.73 | -3.83 | -2.61  | -0.85  | -1.97  | -2.92  |
| <b>Czech Republic</b> | 2.91  | -2.91 | -5.92 | 1.43   | 4.94   | 4.52  | 3.53  | -0.47  | -4.31  | -10.85 | -12.05 |
| <b>Estonia</b>        | -0.21 | -0.04 | -0.24 | -0.43  | -0.17  | -0.07 | -0.44 | -0.19  | 0.69   | 1.21   | 0.52   |
| <b>Hungary</b>        | 0.22  | 3.39  | 6.24  | -2.24  | -0.58  | -0.02 | 3.26  | 5.48   | 7.36   | 8.33   | 8.43   |
| <b>Latvia</b>         | -0.58 | -0.91 | -0.92 | -0.51  | -0.26  | -0.66 | -1.60 | 0.15   | 1.12   | 0.07   | -1.91  |
| <b>Lithuania</b>      | 0.84  | 3.29  | 3.88  | 1.09   | -2.49  | -3.33 | -1.86 | -1.33  | -3.07  | -4.87  | -4.74  |
| <b>Poland</b>         | 2.19  | -1.97 | -9.75 | -11.96 | -10.27 | -8.17 | -7.06 | -10.57 | -15.60 | -20.88 | -22.32 |
| <b>Romania</b>        | 5.03  | 5.29  | -2.78 | -4.38  | 9.62   | 6.84  | 10.84 | 11.61  | 13.71  | 7.40   | 2.97   |
| <b>Slovakia</b>       | 2.17  | 0.94  | -4.22 | -3.45  | -3.56  | -2.70 | -3.33 | -7.83  | -13.81 | -19.69 | -21.57 |

### III. Causalities of the dependency ratio and economic, educational, and social variables:

The following section introduces the results of the causality links between the change in the demographic composition, or the dependency ratio, with unemployment, economic development, expenditure, education, and female education variables. The significance level that determines the significant causalities is 5%.

#### 1. **Causality tests of the dependency ratio and unemployment variables in ECE countries:**

Tables 5, 6, and 7 summarizes the results of the causalities between the dependency ratio and unemployment variables.

In the case of Croatia, the dependency ratio causes the total labor force and is caused by the youth labor force participation while in the Czech Republic, the dependency

ratio causes both the females and males unemployment and is caused by the total labor force. In Estonia and Bulgaria, no causalities are found (Table 5).

**Table 5: Granger causality of the dependency ratio and employment variables in ECE countries (set 1):**

| Country   | Bulgaria    |       | Croatia     |       | Czech Republic |       | Estonia     |       |
|---|-------------|-------|-------------|-------|----------------|-------|-------------|-------|
|   | F-statistic | Prob. | F-statistic | Prob. | F-statistic    | Prob. | F-statistic | Prob. |
| <b>LABORFORCETOTAL does not Granger Cause DR</b>          | 0.349       | 0.709 | 0.209       | 0.812 | 3.825          | 0.039 | 0.667       | 0.524 |
| <b>DR does not Granger Cause LABORFORCETOTAL</b>          | 0.275       | 0.762 | 5.126       | 0.015 | 3.239          | 0.060 | 2.203       | 0.136 |
| <b>LABORFORCEFEMALE does not Granger Cause DR</b>         | 1.351       | 0.281 | 2.635       | 0.096 | 1.804          | 0.190 | 1.771       | 0.197 |
| <b>DR does not Granger Cause LABORFORCEFEMALE</b>         | 0.598       | 0.559 | 2.341       | 0.121 | 1.710          | 0.206 | 2.520       | 0.105 |
| <b>UNEMPLOYMENTTOTAL does not Granger Cause DR</b>        | 0.046       | 0.954 | 0.449       | 0.644 | 0.570          | 0.574 | 0.508       | 0.609 |
| <b>DR does not Granger Cause UNEMPLOYMENTTOTAL</b>        | 2.144       | 0.144 | 1.462       | 0.256 | 2.967          | 0.075 | 0.535       | 0.593 |
| <b>UNEMPLOYMENTYOUNGFEMALE does not Granger Cause DR</b>  | 0.009       | 0.990 | 0.127       | 0.880 | 0.040          | 0.960 | 0.474       | 0.629 |
| <b>DR does not Granger Cause UNEMPLOYMENTYOUNGFEMALE</b>  | 3.411       | 0.054 | 1.321       | 0.290 | 4.119          | 0.032 | 0.689       | 0.513 |
| <b>UNEMPLOYMENTYOUNGMALE does not Granger Cause DR</b>    | 0.052       | 0.949 | 0.108       | 0.897 | 0.018          | 0.981 | 1.554       | 0.237 |
| <b>DR does not Granger Cause UNEMPLOYMENTYOUNGMALE</b>    | 1.963       | 0.167 | 1.481       | 0.252 | 4.083          | 0.033 | 0.735       | 0.492 |
| <b>YOUTHLABORFORCEPARTICIPA does not Granger Cause DR</b> | 2.2789      | 0.128 | 4.310       | 0.027 | 2.369          | 0.119 | 0.241       | 0.787 |
| <b>DR does not Granger Cause YOUTHLABORFORCEPARTICIPA</b> | 0.127       | 0.881 | 0.477       | 0.627 | 2.055          | 0.154 | 3.059       | 0.069 |

But for Hungary, the dependency ratio causes the total labor force, is caused by the youth participation in the labor force and has a double causality with the female labor force. In Lithuania, only the total unemployment causes the dependency ratio. No causalities are found for Latvia (Table 6).

**Table 6: Granger causality of the dependency ratio and employment variables in ECE countries (set2):**

| Country  | Hungary     |       | Latvia      |       | Lithuania   |       |
|--|-------------|-------|-------------|-------|-------------|-------|
|  | F-statistic | Prob. | F-statistic | Prob. | F-statistic | Prob. |
| <b>LABORFORCETOTAL does not Granger Cause DR</b> | 1.467       | 0.254 | 1.762       | 0.197 | 0.630       | 0.542 |

|   |       |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|-------|
| <b>DR does not Granger Cause LABORFORCETOTAL</b>          | 7.674 | 0.003 | 1.051 | 0.367 | 0.347 | 0.710 |
| <b>LABORFORCEFEMALE does not Granger Cause DR</b>         | 3.550 | 0.047 | 2.868 | 0.080 | 0.393 | 0.680 |
| <b>DR does not Granger Cause LABORFORCEFEMALE</b>         | 4.891 | 0.018 | 1.500 | 0.247 | 2.148 | 0.142 |
| <b>UNEMPLOYMENTTOTAL does not Granger Cause DR</b>        | 1.776 | 0.196 | 2.742 | 0.089 | 3.670 | 0.044 |
| <b>DR does not Granger Cause UNEMPLOYMENTTOTAL</b>        | 0.615 | 0.551 | 0.289 | 0.751 | 1.687 | 0.211 |
| <b>UNEMPLOYMENTYOUNGFEMALE does not Granger Cause DR</b>  | 3.161 | 0.065 | 2.023 | 0.159 | 2.933 | 0.077 |
| <b>DR does not Granger Cause UNEMPLOYMENTYOUNGFEMALE</b>  | 1.070 | 0.362 | 0.047 | 0.954 | 0.286 | 0.754 |
| <b>UNEMPLOYMENTYOUNGMALE does not Granger Cause DR</b>    | 3.027 | 0.072 | 1.748 | 0.200 | 2.704 | 0.092 |
| <b>DR does not Granger Cause UNEMPLOYMENTYOUNGMALE</b>    | 0.383 | 0.687 | 0.186 | 0.831 | 0.366 | 0.698 |
| <b>YOUTHLABORFORCEPARTICIPA does not Granger Cause DR</b> | 3.716 | 0.042 | 0.540 | 0.590 | 3.013 | 0.071 |
| <b>DR does not Granger Cause YOUTHLABORFORCEPARTICIPA</b> | 1.127 | 0.343 | 2.466 | 0.110 | 3.275 | 0.058 |

In the case of Poland, the dependency ratio has a double causality with the total labor force, and causes total unemployment, and male and females unemployment. While in Romania the dependency ratio only causes the total labor force and the females labor force, it causes in Slovakia the total labor force, is caused by female labor force, and has a double causality youth participation in the labor force (Table 7).

**Table 7: Granger causality of the dependency ratio and employment variables in ECE countries (set3):**

| Country  | Poland      |       | Romania     |       | Slovakia    |       |
|--|-------------|-------|-------------|-------|-------------|-------|
|  | F-statistic | Prob. | F-statistic | Prob. | F-statistic | Prob. |
| <b>LABORFORCETOTAL does not Granger Cause DR</b>         | 10.250      | 0.000 | 3.424       | 0.052 | 2.797       | 0.084 |
| <b>DR does not Granger Cause LABORFORCETOTAL</b>         | 5.033       | 0.017 | 4.943       | 0.018 | 13.112      | 0.000 |
| <b>LABORFORCEFEMALE does not Granger Cause DR</b>        | 1.630       | 0.220 | 1.245       | 0.309 | 4.396       | 0.026 |
| <b>DR does not Granger Cause LABORFORCEFEMALE</b>        | 1.850       | 0.183 | 3.884       | 0.037 | 1.165       | 0.331 |
| <b>UNEMPLOYMENTTOTAL does not Granger Cause DR</b>       | 2.917       | 0.078 | 1.726       | 0.204 | 0.045       | 0.956 |
| <b>DR does not Granger Cause UNEMPLOYMENTTOTAL</b>       | 5.646       | 0.011 | 0.183       | 0.833 | 1.402       | 0.270 |
| <b>UNEMPLOYMENTYOUNGFEMALE does not Granger Cause DR</b> | 3.103       | 0.068 | 3.181       | 0.064 | 0.080       | 0.923 |

|   |       |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|-------|
| <b>DR does not Granger Cause<br/>UNEMPLOYMENTYOUNGFEMALE</b>  | 5.233 | 0.015 | 1.194 | 0.324 | 0.655 | 0.530 |
| <b>UNEMPLOYMENTYOUNGMALE<br/>does not Granger Cause DR</b>    | 2.607 | 0.099 | 1.095 | 0.354 | 0.088 | 0.915 |
| <b>DR does not Granger Cause<br/>UNEMPLOYMENTYOUNGMALE</b>    | 3.623 | 0.046 | 0.918 | 0.416 | 0.592 | 0.562 |
| <b>YOUTHLABORFORCEPARTICIPA<br/>does not Granger Cause DR</b> | 0.519 | 0.602 | 0.998 | 0.386 | 8.987 | 0.001 |
| <b>DR does not Granger Cause<br/>YOUTHLABORFORCEPARTICIPA</b> | 0.393 | 0.679 | 1.331 | 0.286 | 5.235 | 0.014 |

## 2. Granger causality between the dependency ratio and economic development variables in ECE countries:

Tables 8, 9, and 10 summarizes the causal links between economic development variables and the dependency ratio.

In Bulgaria, no causal links are found. But in Croatia, the dependency ratio causes the GDP per capita. In addition to that, in both Croatia, and the Czech Republic, the dependency ratio causes the gross savings. For Estonia, it is the GDP per capita growth that causes the dependency ratio (Table 8).

**Table 8: Granger causality of the dependency ratio and economic development variables in ECE countries (set1):**

| Country  | Bulgaria    |       | Croatia     |       | Czech Republic |       | Estonia     |       |
|--|-------------|-------|-------------|-------|----------------|-------|-------------|-------|
|  | F-statistic | Prob. | F-statistic | Prob. | F-statistic    | Prob. | F-statistic | Prob. |
| <b>GDPPERCAPITA does not Granger Cause DR</b>          | 0.703       | 0.502 | 0.528       | 0.599 | 0.642          | 0.536 | 0.063       | 0.938 |
| <b>DR does not Granger Cause GDPPERCAPITA</b>          | 1.648       | 0.209 | 5.806       | 0.013 | 0.431          | 0.655 | 2.326       | 0.131 |
| <b>GDPPERCAPITAGROWTH does not Granger Cause DR</b>    | 0.838       | 0.442 | 2.572       | 0.111 | 0.001          | 0.998 | 3.893       | 0.045 |
| <b>DR does not Granger Cause GDPPERCAPITAGROWTH</b>    | 1.290       | 0.290 | 0.176       | 0.839 | 0.414          | 0.666 | 0.869       | 0.440 |
| <b>GROSSSAVINGS does not Granger Cause DR</b>          | 0.755       | 0.478 | 0.699       | 0.513 | 1.935          | 0.174 | 0.172       | 0.843 |
| <b>DR does not Granger Cause GROSSSAVINGS</b>          | 0.017       | 0.982 | 6.463       | 0.010 | 4.723          | 0.023 | 1.514       | 0.266 |
| <b>AGRICULTUREVALUEADDED does not Granger Cause DR</b> | 2.672       | 0.085 | 2.104       | 0.156 | 0.131          | 0.877 | 3.045       | 0.077 |
| <b>DR does not Granger Cause AGRICULTUREVALUEADDED</b> | 2.512       | 0.098 | 3.426       | 0.059 | 0.748          | 0.488 | 1.049       | 0.374 |
| <b>INDUSTRYVALUEADDED does not Granger Cause DR</b>    | 2.142       | 0.134 | 1.122       | 0.351 | 0.147          | 0.864 | 0.827       | 0.456 |
| <b>DR does not Granger Cause INDUSTRYVALUEADDED</b>    | 0.142       | 0.867 | 0.363       | 0.701 | 1.747          | 0.204 | 1.425       | 0.271 |

|                           |  |  |  |  |  |  |  |  |
|---------------------------|--|--|--|--|--|--|--|--|
| <b>INDUSTRYVALUEADDED</b> |  |  |  |  |  |  |  |  |
|---------------------------|--|--|--|--|--|--|--|--|

The dependency ratio causes the industry value added in Hungary, causes the agriculture value added in Latvia, and is caused by both the GDP per capita growth and the industry value added in Lithuania (Table 9).

**Table 9: Granger causality of the dependency ratio and economic development variables in ECE countries (set2):**

| Country  | Hungary     |       | Latvia      |       | Lithuania   |       |
|--|-------------|-------|-------------|-------|-------------|-------|
|  | F-statistic | Prob. | F-statistic | Prob. | F-statistic | Prob. |
| <b>GDPPERCAPITA does not Granger Cause DR</b>          | 0.296       | 0.746 | 0.342       | 0.715 | 0.424       | 0.661 |
| <b>DR does not Granger Cause GDPPERCAPITA</b>          | 0.266       | 0.769 | 3.386       | 0.061 | 0.947       | 0.409 |
| <b>GDPPERCAPITAGROWTH does not Granger Cause DR</b>    | 0.662       | 0.527 | 1.217       | 0.325 | 9.150       | 0.002 |
| <b>DR does not Granger Cause GDPPERCAPITAGROWTH</b>    | 0.710       | 0.504 | 1.357       | 0.289 | 0.397       | 0.679 |
| <b>GROSSSAVINGS does not Granger Cause DR</b>          | 2.953       | 0.079 | 1.359       | 0.286 | 4.309       | 0.069 |
| <b>DR does not Granger Cause GROSSSAVINGS</b>          | 1.888       | 0.181 | 2.312       | 0.133 | 3.963       | 0.080 |
| <b>AGRICULTUREVALUEADDED does not Granger Cause DR</b> | 0.326       | 0.726 | 0.383       | 0.687 | 0.328       | 0.724 |
| <b>DR does not Granger Cause AGRICULTUREVALUEADDED</b> | 0.596       | 0.563 | 5.679       | 0.014 | 0.076       | 0.927 |
| <b>INDUSTRYVALUEADDED does not Granger Cause DR</b>    | 3.198       | 0.069 | 0.650       | 0.536 | 4.023       | 0.039 |
| <b>DR does not Granger Cause INDUSTRYVALUEADDED</b>    | 7.882       | 0.004 | 0.350       | 0.709 | 0.966       | 0.402 |

In the case of Poland, no causalities are found between the economic development variables and the dependency ratio. This latter causes the GDP per capita in Slovakia, and causes the agriculture value added in both Romania and Slovakia (Table 10).

**Table 10: Granger causality of the dependency ratio and economic development variables in ECE countries (set3):**

| Country                                       | Poland      |       | Romania     |       | Slovakia    |       |
|---|-------------|-------|-------------|-------|-------------|-------|
|   | F-statistic | Prob. | F-statistic | Prob. | F-statistic | Prob. |
| <b>GDPPERCAPITA does not Granger Cause DR</b> | 2.168       | 0.140 | 3.333       | 0.056 | 0.238       | 0.790 |



|  |       |       |       |       |       |       |
|--|-------|-------|-------|-------|-------|-------|
| <b>DR does not Granger Cause GDPPERCAPITA</b>          | 0.337 | 0.717 | 0.534 | 0.594 | 4.877 | 0.020 |
| <b>GDPPERCAPITAGROWTH does not Granger Cause DR</b>    | 0.863 | 0.437 | 0.924 | 0.413 | 2.240 | 0.136 |
| <b>DR does not Granger Cause GDPPERCAPITAGROWTH</b>    | 1.169 | 0.332 | 0.399 | 0.676 | 0.619 | 0.549 |
| <b>GROSSSAVINGS does not Granger Cause DR</b>          | 0.935 | 0.409 | 0.867 | 0.435 | 0.906 | 0.424 |
| <b>DR does not Granger Cause GROSSSAVINGS</b>          | 1.071 | 0.362 | 1.977 | 0.164 | 3.382 | 0.061 |
| <b>AGRICULTUREVALUEADDED does not Granger Cause DR</b> | 1.061 | 0.370 | 1.206 | 0.320 | 0.605 | 0.558 |
| <b>DR does not Granger Cause AGRICULTUREVALUEADDED</b> | 0.857 | 0.444 | 5.118 | 0.016 | 7.005 | 0.007 |
| <b>INDUSTRYVALUEADDED does not Granger Cause DR</b>    | 2.390 | 0.125 | 0.594 | 0.561 | 0.722 | 0.501 |
| <b>DR does not Granger Cause INDUSTRYVALUEADDED</b>    | 0.194 | 0.825 | 0.695 | 0.510 | 2.174 | 0.148 |

### 3. Granger causality between the dependency ratio and expenditure variables in ECE countries:

Tables 11, 12, and 13 summarizes the Granger causalities between the dependency ratio and the expenditure variables.

In Bulgaria, the dependency ratio causes expenditure on education. In Croatia, the dependency ratio causes both expenditure on education and expenditure per capita on health. But in Czech Republic, the dependency ratio has a double causality with expenditure on education, and causes both the expenditure per capita on health and expenditure on private health. The results of Estonia indicate that the dependency ratio has a double causality with per capita expenditure on health and is caused by expenditure on private health (Table 11).

**Table 11: Granger causality of the dependency ratio and expenditure variables in ECE countries (set1):**

| Country   | Bulgaria    |       | Croatia     |       | Czech Republic |       | Estonia     |       |
|---|-------------|-------|-------------|-------|----------------|-------|-------------|-------|
|   | F-statistic | Prob. | F-statistic | Prob. | F-statistic    | Prob. | F-statistic | Prob. |
| <b>EDUCATIONEXPENDITURE does not Granger Cause DR</b>     | 2.401       | 0.108 | 1.670       | 0.223 | 6.264          | 0.009 | 1.710       | 0.234 |
| <b>DR does not Granger Cause EDUCATIONEXPENDITURE</b>     | 8.536       | 0.001 | 5.775       | 0.014 | 4.415          | 0.028 | 1.629       | 0.248 |
| <b>HEALTHEXPENDITUREPERCAPI does not Granger Cause DR</b> | 0.822       | 0.460 | 2.174       | 0.153 | 3.269          | 0.070 | 4.060       | 0.042 |

|   |       |       |       |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>DR does not Granger Cause<br/>HEALTHEXPENDITUREPERCAPI</b> | 0.329 | 0.725 | 6.872 | 0.009 | 5.096 | 0.023 | 6.182 | 0.013 |
| <b>HEALTHEXPENDITUREPRIVATE<br/>does not Granger Cause DR</b> | 0.130 | 0.879 | 0.372 | 0.696 | 3.681 | 0.054 | 4.877 | 0.026 |
| <b>DR does not Granger Cause<br/>HEALTHEXPENDITUREPRIVATE</b> | 0.717 | 0.506 | 1.145 | 0.348 | 4.064 | 0.042 | 3.198 | 0.074 |
| <b>HEALTHEXPENDITUREPUBLIC<br/>does not Granger Cause DR</b>  | 1.228 | 0.324 | 3.522 | 0.059 | 0.887 | 0.435 | 1.301 | 0.305 |
| <b>DR does not Granger Cause<br/>HEALTHEXPENDITUREPUBLIC</b>  | 2.218 | 0.148 | 0.236 | 0.792 | 1.001 | 0.394 | 2.322 | 0.137 |
| <b>HEALTHEXPENDITURETOTAL<br/>does not Granger Cause DR</b>   | 0.901 | 0.429 | 3.722 | 0.052 | 2.352 | 0.134 | 3.424 | 0.063 |
| <b>DR does not Granger Cause<br/>HEALTHEXPENDITURETOTAL</b>   | 1.721 | 0.217 | 0.367 | 0.699 | 2.483 | 0.122 | 2.825 | 0.095 |

Empirical results indicate that for Hungary, the dependency ratio has a double causality with expenditure on education, and causes expenditure on public health. In Latvia, the dependency ratio causes both the expenditure on education and the expenditure per capita on health. For Lithuania, the dependency ratio causes only the expenditure on private health (Table 12).

**Table 12: Granger causality of the dependency ratio and expenditure variables in ECE countries (set2):**

| Country   | Hungary     |       | Latvia      |       | Lithuania   |       |
|---|-------------|-------|-------------|-------|-------------|-------|
|   | F-statistic | Prob. | F-statistic | Prob. | F-statistic | Prob. |
| <b>EDUCATIONEXPENDITURE does not Granger Cause DR</b>     | 6.234       | 0.010 | 1.013       | 0.388 | 0.545       | 0.610 |
| <b>DR does not Granger Cause EDUCATIONEXPENDITURE</b>     | 4.515       | 0.027 | 7.173       | 0.007 | 0.573       | 0.596 |
| <b>HEALTHEXPENDITUREPERCAPI does not Granger Cause DR</b> | 3.376       | 0.065 | 1.714       | 0.218 | 0.968       | 0.405 |
| <b>DR does not Granger Cause HEALTHEXPENDITUREPERCAPI</b> | 2.953       | 0.087 | 10.216      | 0.002 | 2.216       | 0.148 |
| <b>HEALTHEXPENDITUREPRIVATE does not Granger Cause DR</b> | 0.676       | 0.525 | 0.070       | 0.932 | 3.522       | 0.059 |
| <b>DR does not Granger Cause HEALTHEXPENDITUREPRIVATE</b> | 0.741       | 0.495 | 3.691       | 0.053 | 5.935       | 0.014 |
| <b>HEALTHEXPENDITUREPUBLIC does not Granger Cause DR</b>  | 0.481       | 0.628 | 3.561       | 0.058 | 1.407       | 0.279 |
| <b>DR does not Granger Cause HEALTHEXPENDITUREPUBLIC</b>  | 4.163       | 0.040 | 0.939       | 0.415 | 0.553       | 0.587 |
| <b>HEALTHEXPENDITURETOTAL does not Granger Cause DR</b>   | 0.104       | 0.901 | 2.668       | 0.106 | 1.840       | 0.197 |
| <b>DR does not Granger Cause HEALTHEXPENDITURETOTAL</b>   | 2.561       | 0.115 | 1.834       | 0.198 | 1.252       | 0.318 |

In Romania, no causal links are found between expenditure variables and the dependency ratio. In Poland, the dependency ratio only causes the expenditure on total and public health. In the case of Slovakia, the dependency ratio causes all expenditure variables (Table 13).

**Table 13: Granger causality of the dependency ratio and expenditure variables in ECE countries (set3):**

| Country   | Poland      |       | Romania     |       | Slovakia    |       |
|---|-------------|-------|-------------|-------|-------------|-------|
|   | F-statistic | Prob. | F-statistic | Prob. | F-statistic | Prob. |
| <b>EDUCATIONEXPENDITURE does not Granger Cause DR</b>     | 0.320       | 0.729 | 2.628       | 0.097 | 1.791       | 0.203 |
| <b>DR does not Granger Cause EDUCATIONEXPENDITURE</b>     | 3.105       | 0.069 | 2.454       | 0.111 | 5.688       | 0.015 |
| <b>HEALTHEXPENDITUREPERCAPI does not Granger Cause DR</b> | 0.844       | 0.452 | 3.123       | 0.078 | 3.090       | 0.079 |
| <b>DR does not Granger Cause HEALTHEXPENDITUREPERCAPI</b> | 2.636       | 0.109 | 2.105       | 0.161 | 5.169       | 0.022 |
| <b>HEALTHEXPENDITUREPRIVATE does not Granger Cause DR</b> | 0.559       | 0.584 | 0.849       | 0.450 | 2.562       | 0.115 |
| <b>DR does not Granger Cause HEALTHEXPENDITUREPRIVATE</b> | 3.159       | 0.076 | 0.929       | 0.419 | 4.046       | 0.043 |
| <b>HEALTHEXPENDITUREPUBLIC does not Granger Cause DR</b>  | 0.239       | 0.790 | 0.054       | 0.946 | 3.304       | 0.069 |
| <b>DR does not Granger Cause HEALTHEXPENDITUREPUBLIC</b>  | 6.418       | 0.011 | 0.028       | 0.972 | 8.262       | 0.004 |
| <b>HEALTHEXPENDITURETOTAL does not Granger Cause DR</b>   | 0.680       | 0.523 | 0.022       | 0.977 | 3.385       | 0.065 |
| <b>DR does not Granger Cause HEALTHEXPENDITURETOTAL</b>   | 5.205       | 0.021 | 0.082       | 0.921 | 5.107       | 0.023 |

#### 4. Granger causality between the dependency ratio and education variables in ECE countries

Tables 14, 15, and 16, summarizes the Granger causalities between education variables and the dependency ratio.

Findings does not show any significant causalities in both Bulgaria and Croatia. For the Czech Republic, the dependency ratio causes secondary, secondary vocational, and secondary general education. But in Estonia, both the secondary, and secondary general education cause the dependency ratio (Table 14).

**Table 14: Granger causality of the dependency ratio and education variables in ECE countries (set1):**

| Country  | Bulgaria    |       | Croatia     |       | Czech Republic |       | Estonia     |       |
|--|-------------|-------|-------------|-------|----------------|-------|-------------|-------|
|  | F-statistic | Prob. | F-statistic | Prob. | F-statistic    | Prob. | F-statistic | Prob. |
| <b>PRIMARY does not Granger Cause DR</b>             | 1.808       | 0.177 | 1.474       | 0.264 | 0.224          | 0.800 | 0.904       | 0.416 |
| <b>DR does not Granger Cause PRIMARY</b>             | 1.631       | 0.209 | 2.039       | 0.169 | 1.999          | 0.150 | 2.431       | 0.106 |
| <b>SECONDARY does not Granger Cause DR</b>           | 0.900       | 0.414 | 1.219       | 0.327 | 1.158          | 0.325 | 4.153       | 0.034 |
| <b>DR does not Granger Cause SECONDARY</b>           | 1.241       | 0.300 | 0.407       | 0.673 | 5.278          | 0.009 | 2.868       | 0.084 |
| <b>SECONDARYVOCATIONAL does not Granger Cause DR</b> | 0.931       | 0.402 | 1.258       | 0.316 | 0.126          | 0.881 | 2.018       | 0.163 |
| <b>DR does not Granger Cause SECONDARYVOCATIONAL</b> | 0.191       | 0.826 | 0.336       | 0.720 | 5.140          | 0.011 | 1.615       | 0.228 |
| <b>SECONDARYGENERAL does not Granger Cause DR</b>    | 0.875       | 0.424 | 2.494       | 0.121 | 2.361          | 0.109 | 8.389       | 0.001 |
| <b>DR does not Granger Cause SECONDARYGENERAL</b>    | 2.073       | 0.139 | 0.621       | 0.552 | 3.606          | 0.037 | 2.695       | 0.085 |

In Hungary, the dependency ratio has a double causality with primary education, and is caused by secondary general education while in Latvia, the dependency ratio is caused by primary education, and causes all types of secondary education. In Lithuania, the dependency ratio causes both the secondary and the secondary general education (Table 15).

**Table 15: Granger causality of the dependency ratio and education variables in ECE countries (set2):**

| Country  | Hungary     |       | Latvia      |       | Lithuania   |       |
|--|-------------|-------|-------------|-------|-------------|-------|
|  | F-statistic | Prob. | F-statistic | Prob. | F-statistic | Prob. |
| <b>PRIMARY does not Granger Cause DR</b>             | 9.296       | 0.000 | 3.980       | 0.030 | 1.909       | 0.174 |
| <b>DR does not Granger Cause PRIMARY</b>             | 10.784      | 0.000 | 1.250       | 0.301 | 1.371       | 0.276 |
| <b>SECONDARY does not Granger Cause DR</b>           | 0.350       | 0.706 | 0.317       | 0.730 | 0.250       | 0.780 |
| <b>DR does not Granger Cause SECONDARY</b>           | 3.017       | 0.061 | 5.548       | 0.009 | 8.450       | 0.002 |
| <b>SECONDARYVOCATIONAL does not Granger Cause DR</b> | 2.349       | 0.110 | 1.213       | 0.318 | 0.915       | 0.416 |
| <b>DR does not Granger Cause SECONDARYVOCATIONAL</b> | 2.805       | 0.074 | 4.652       | 0.021 | 3.176       | 0.063 |

|   |       |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|-------|
| <b>SECONDARYGENERAL does not Granger Cause DR</b> | 6.581 | 0.003 | 0.620 | 0.547 | 1.293 | 0.296 |
| <b>DR does not Granger Cause SECONDARYGENERAL</b> | 0.216 | 0.806 | 6.124 | 0.008 | 6.015 | 0.009 |

In the case of Poland, the dependency ratio has a double causality with primary education, is caused by both secondary and secondary general education, and causes the secondary vocational education. For Romania, the dependency ratio causes the primary education and is caused by the secondary general education. In Slovakia, the dependency ratio causes all education variables, except the secondary general education (Table 16).

**Table 16: Granger causality of the dependency ratio and education variables in ECE countries (set3):**

| Country  | Poland      |        | Romania     |       | Slovakia    |       |
|--|-------------|--------|-------------|-------|-------------|-------|
|  | F-statistic | Prob.  | F-statistic | Prob. | F-statistic | Prob. |
| <b>PRIMARY does not Granger Cause DR</b>             | 7.087       | 0.002  | 0.435       | 0.652 | 1.681       | 0.214 |
| <b>DR does not Granger Cause PRIMARY</b>             | 9.814       | 0.000  | 6.742       | 0.005 | 4.253       | 0.030 |
| <b>SECONDARY does not Granger Cause DR</b>           | 5.241       | 0.009  | 2.897       | 0.076 | 2.046       | 0.161 |
| <b>DR does not Granger Cause SECONDARY</b>           | 2.999       | 0.062  | 2.581       | 0.098 | 7.032       | 0.006 |
| <b>SECONDARYVOCATIONAL does not Granger Cause DR</b> | 0.254       | 0.776  | 0.460       | 0.635 | 1.099       | 0.356 |
| <b>DR does not Granger Cause SECONDARYVOCATIONAL</b> | 5.205       | 0.010  | 2.203       | 0.127 | 4.721       | 0.024 |
| <b>SECONDARYGENERAL does not Granger Cause DR</b>    | 12.229      | 8.E-05 | 5.403       | 0.013 | 1.557       | 0.240 |
| <b>DR does not Granger Cause SECONDARYGENERAL</b>    | 0.896       | 0.416  | 0.373       | 0.693 | 3.077       | 0.074 |

### 5. Granger causality between the dependency ratio and female participation in education in ECE countries:

Tables 17, 18, and 19, summarizes the causal links between the dependency ratio and female participation in education variables.

In Bulgaria, it is the female participation in primary education that causes the dependency ratio. In Czech Republic, the dependency ratio causes both female

participation in secondary vocational and secondary education. In Estonia, the dependency ratio causes the female participation in female primary education, and is caused by female participation in all types of secondary education. But for Croatia, no significant causal links are found (Table 17).

**Table 17: Granger causality of the dependency ratio and female participation in education variables in ECE countries (set1):**

| Country   | Bulgaria    |       | Croatia     |       | Czech Republic |       | Estonia     |       |
|---|-------------|-------|-------------|-------|----------------|-------|-------------|-------|
|   | F-statistic | Prob. | F-statistic | Prob. | F-statistic    | Prob. | F-statistic | Prob. |
| <b>FEMPRIMARY does not Granger Cause DR</b>             | 5.390       | 0.008 | 0.569       | 0.579 | 1.807          | 0.179 | 0.686       | 0.511 |
| <b>DR does not Granger Cause PRIMARYFEM</b>             | 0.179       | 0.836 | 1.176       | 0.339 | 0.896          | 0.417 | 4.642       | 0.018 |
| <b>FEMSECONDARYGENERAL does not Granger Cause DR</b>    | 1.185       | 0.316 | 0.313       | 0.736 | 0.918          | 0.408 | 4.719       | 0.017 |
| <b>DR does not Granger Cause SECONDARYGENERALFEM</b>    | 2.196       | 0.125 | 2.397       | 0.130 | 1.784          | 0.182 | 0.697       | 0.506 |
| <b>FEMSECONDARYVOCATIONAL does not Granger Cause DR</b> | 0.430       | 0.653 | 1.398       | 0.281 | 0.494          | 0.613 | 5.394       | 0.018 |
| <b>DR does not Granger Cause SECONDARYVOCATIONALFEM</b> | 2.964       | 0.063 | 0.624       | 0.550 | 4.040          | 0.026 | 0.681       | 0.522 |
| <b>FEMSECONDARY does not Granger Cause DR</b>           | 0.294       | 0.746 | 1.124       | 0.354 | 0.284          | 0.754 | 4.132       | 0.038 |
| <b>DR does not Granger Cause SECONDARYFEM</b>           | 2.676       | 0.081 | 0.736       | 0.497 | 3.888          | 0.029 | 1.266       | 0.312 |

While Lithuania does not show any significant causalities, the dependency ratio is caused by female participation in secondary general education in Hungary, and is caused by female participation in primary education in Latvia (Table 18).

**Table 18: Granger causality of the dependency ratio and female participation in education variables in ECE countries (set2):**

| Country  | Hungary     |       | Latvia      |        | Lithuania   |       |
|--|-------------|-------|-------------|--------|-------------|-------|
|  | F-statistic | Prob. | F-statistic | Prob.  | F-statistic | Prob. |
| <b>FEMPRIMARY does not Granger Cause DR</b>          | 0.364       | 0.697 | 23.432      | 6.E-06 | 1.242       | 0.312 |
| <b>DR does not Granger Cause PRIMARYFEM</b>          | 1.937       | 0.159 | 2.425       | 0.114  | 0.135       | 0.873 |
| <b>FEMSECONDARYGENERAL does not Granger Cause DR</b> | 3.987       | 0.027 | 0.912       | 0.419  | 1.965       | 0.176 |
| <b>DR does not Granger Cause SECONDARYGENERALFEM</b> | 2.017       | 0.148 | 0.267       | 0.768  | 1.415       | 0.275 |

|   |       |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|-------|
| <b>FEMSECONDARYVOCATIONAL does not Granger Cause DR</b> | 0.161 | 0.851 | 1.560 | 0.237 | 0.023 | 0.976 |
| <b>DR does not Granger Cause SECONDARYVOCATIONALFEM</b> | 3.005 | 0.062 | 1.462 | 0.257 | 2.477 | 0.113 |
| <b>FEMSECONDARY does not Granger Cause DR</b>           | 1.745 | 0.189 | 2.684 | 0.095 | 2.522 | 0.116 |
| <b>DR does not Granger Cause SECONDARYFEM</b>           | 1.647 | 0.207 | 0.749 | 0.486 | 2.228 | 0.144 |

In Poland, the dependency ratio is caused by both female participation in primary education and secondary vocational education. In Romania, the dependency ratio causes the female participation in both secondary general and secondary education. Finally, in Slovakia, the dependency ratio causes the female participation in primary education and secondary vocational education, and is caused by female participation in secondary education (Table 19).

**Table 19: Granger causality of the dependency ratio and female participation in education variables in ECE countries (set3):**

| Country   | Poland      |       | Romania     |       | Slovakia    |       |
|---|-------------|-------|-------------|-------|-------------|-------|
|   | F-statistic | Prob. | F-statistic | Prob. | F-statistic | Prob. |
| <b>FEMPRIMARY does not Granger Cause DR</b>             | 5.236       | 0.014 | 0.327       | 0.724 | 0.469       | 0.632 |
| <b>DR does not Granger Cause PRIMARYFEM</b>             | 0.847       | 0.443 | 1.636       | 0.220 | 4.453       | 0.026 |
| <b>FEMSECONDARYGENERAL does not Granger Cause DR</b>    | 0.839       | 0.446 | 0.761       | 0.480 | 1.252       | 0.312 |
| <b>DR does not Granger Cause SECONDARYGENERALFEM</b>    | 2.471       | 0.109 | 4.238       | 0.029 | 2.073       | 0.158 |
| <b>FEMSECONDARYVOCATIONAL does not Granger Cause DR</b> | 4.421       | 0.019 | 0.666       | 0.520 | 1.128       | 0.347 |
| <b>DR does not Granger Cause SECONDARYVOCATIONALFEM</b> | 1.168       | 0.321 | 1.491       | 0.240 | 10.253      | 0.001 |
| <b>FEMSECONDARY does not Granger Cause DR</b>           | 2.179       | 0.139 | 4.987       | 0.016 | 4.298       | 0.032 |
| <b>DR does not Granger Cause SECONDARYFEM</b>           | 0.557       | 0.581 | 2.862       | 0.078 | 2.627       | 0.103 |

### Conclusion and Discussion:

The following contributions analyzes the trends of fertility rate and mortality rates in addition to the occurrence of the demographic dividend and the impact of the

demographic change of age structure on educational, social, and economic variables in ECE countries.

The empirical results indicate that the trends of both fertility and mortality rates are significantly decreasing meaning in all the selected economies. In addition to that, the estimation of the demographic dividend indicates that its period has ended for most of ECE countries, except for Estonia, Hungary, and Romania.

With regard to the Granger causality test, results indicate that the decrease of the number of dependents in Bulgaria causes only the government expenditure on education.

The contribution of Koytcheva and Philipov (2008) indicates that the fall of the communism resulted in political and economic changes. This was in addition to an economic crisis in the late 1996 and 1997 that was characterized by high inflation rates and a devaluation of income per capita. Moreover, unemployment was the highest in the 1990s among the youngest segment (Beleva and Tsanov, 2001). The socialist later on created more employment opportunities, with a special focus on the role of women in the labor force and education (Sowards, 1996; Pisankaneva, 2003; Philipov et al., 2006).

The contribution of the European Commission (2016) indicates that the early school leavers or the dropout rate started increasing in 2011. This is why the Bulgarian government needs to increase its expenditure on education besides putting strategies and programs to support youth inclusion and enhance women participation in the labor market.

For Croatia, the dependency ratio causes the increase of the total labor force, the GDP per capita, the gross savings, expenditure on education, health expenditure per capita, but has no causalities with educational variables.

This aligns with the contribution of Čipin and Ilieva (2017). This paper requires an urgent development and enhancement of the health system within this economy besides enhancing the pensions and social programs.



In Croatia, policy makers need to introduce programs and strategies to increase the participation of the newest generation in education while enhancing the existing educational system and reducing the gap between education and employment.

In the case of Czech Republic, the change of the population age structure causes both the females and males unemployment. In addition to that, this variable causes the government gross savings, expenditure on education, health expenditure per capita, and expenditure on private health. But with regard to educational variables, the dependency ratio causes all types of secondary education with more participation of females.

Policy makers in the Czech Republic need to maintain or enhance their existing strategies that relate to education and female participation in education. In addition to that, governments' savings need to be spent on both education and healthcare systems. But with regard to employment, there should be more investment either national or foreign that will provide more job supply.

In Estonia, the dependency ratio causes only the health expenditure per capita, and female participation in primary education. Thus policy makers need to expand the health system.

The lack of causalities within this country is indicated in the contribution of Eamets et al. (2008). This requires further research on the demographic dividend and demographic transition with regard to this economy.

For Hungary, the dependency ratio causes the increase in the total labor force and the female labor. In addition to that, it causes the industry value added, expenditure on education, and expenditure on public health. With regard to educational variables, the dependency ratio causes the increase in the enrolment in primary education.

Policies in Hungary should relate more to youth inclusion by the creation of more job supply with emphasis on the industrial sectors within this economy. Focus should also be on increasing female participation in education.

In Latvia, the change in the population structure causes the agriculture value added, expenditure on education, expenditure on health per capita, and all types of secondary

education. The dependency ratio does not cause any variable of females' participation in education.

The Latvian government needs to enhance the expenditure on education and on health. In addition to that, there should be strategies to attract investment in the agricultural sector, and female participation in both education and labor force.

With regard to Lithuania, the dependency ratio causes the expenditure on private health, secondary education, and secondary vocational education.

Besides putting strategies and programs that will enhance the current educational and healthcare systems, the Lithuanian government needs more research on the impact of the demographic transition on economic and social variables.

In the case of Poland, the dependency ratio causes the total labor force, causes unemployment of both males and females, expenditure on public health, and total health expenditure. Moreover, the dependency ratio causes primary education and secondary vocational education.

The Poland government should increase the job supply by either encouraging entrepreneurship or attracting national and international investments. In addition to that, there should be an enhancement of the healthcare system and more policies of youth inclusion in education and labor force, with emphasis on female participation.

For Romania, the dependency ratio causes the total labor force, female labor force, and agriculture value added. Concerning educational variables, the dependency ratio causes the enrolment in primary education, and female participation in secondary general education.

While the contribution of (Popa, 2012) indicates that the demographic transition affects Romania at a macroeconomic level, Vasile (2004) indicates that the labor force should not be left at the mercy of this natural adjustment.

For this, the Romanian government needs to increase job supply with emphasis on the female participation in the labor force. In addition to that, there should be more investment in the agricultural sector.

In Slovakia, the dependency ratio causes the total labor force, the youth participation in the labor force, the GDP per capita, the agriculture value added, expenditure on education, and expenditure on health per capita, private, and public. The change of the population structure also causes the enrolment in primary education, secondary education, secondary vocational, besides it causes the increase of female participation in primary education and secondary vocational education.

The Slovakian government needs to put in place strategies that will increase more the participation of youth in the labor force, with emphasis on the agriculture sector. In addition to that, the contribution of Kotulič (2012) shows that increasing trends of employment are not the only criteria for better economic development. But there should be policies that target knowledge economy based on learning competence that targets enhancing work quality in the labor force.

Moreover, the policy change need to target increasing the government expenditures on health and education, as these variables are the main drivers of the demographic transition.

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