7. THE TAX EFFECTS OF HEALTH EXPENDITURES ON AGING ECONOMIES: EMPIRICAL EVIDENCE ON SELECTED OECD COUNTRIES

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Abstract

The aim of our study is twofold: i) we examine the effect of aging on public health expenditures; and ii) investigate the fiscal burden of the health expenditures over the period 1965-2012 for selected OECD countries. As empirical methodology, we perform nonlinear unit root test proposed by Kapetanios et al. (2003). Afterwards, we employ Seo (2006) cointegration test based on a threshold vector error correction model (TVECM). We find evidence supporting the impact of aging population on the public health expenditures, thus on the tax burden for all countries with the exception of Japan, Sweden and the US.

Keywords: health expenditure, aging, tax, cointegration
JEL Classification: C32, H51, I18.

1. Introduction

There has been a marked upward trend in total health expenditures over the last four decades, particularly across OECD countries. Total health expenditures in ten-year averages across OECD countries increased from 4 to 9.3 percent in proportion to GDP since 1960 (OECD, 2013). The share of public health expenditures in total health expenditures has grown more rapidly in real terms, from 60 to 70 percent (OECD, 2013). A similar trend was observed in the share of health expenditures in general government expenditure; such a share of public health expenditures in general government expenditure increased by over 15% across the EU countries over the last decade,

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demonstrating the sharpest growth after social protection and social security expenditures (Eurostat, 2014).

A vast literature deals with factors which have influence on the health care expenditures. Within those factors, our study pays a special attention to the effect of aging on the public health expenditures. Ageing, that is, the increase in the share of the population over 40 and 65 years of age is one of the key drivers of the real growth of health expenditures. According to OECD (2013), the share of the population over 65 years of age, of 15% in 2010, is expected to reach 29% in 2050. In developing countries such as Turkey, Brazil, China, and Slovakia, there is a much sharper increase, from 7-8% to 23-26%, indicating that ageing will become a more distinct element of fiscal pressure. More briefly, although the degree of the aging problem varies across the OECD countries, as it is higher in the EU area, the following decades will probably witness the acceleration of aging all over the world. Thus, the average share of population over 65, which was 15% in 2010, is expected to reach 27% in 2050 in the 34 OECD countries.

Besides the determinants of public health expenditures, the finance aspect which is not adequately considered in the current health studies should also be examined. With the exception of countries like the US, which finances health system mostly by private insurance, other OECD countries largely finance the system via public funds. Our study that stems from this point aims to investigate the long- and short-run relationship between the tax burden and the public health expenditures, after analyzing the effects of the share of older population as a determinant of public health expenditures for 13 OECD countries over the period 1965-2012. Since the linear models have limitations to model asymmetric behavior of the series and regime shifts, we utilize nonlinear methods to model public health expenditures and taxes which potentially carry nonlinear properties. As methodology, following nonlinear unit root testing procedure of Kapetanios *et al*. (2003) which is employed to examine the stationarity properties of the series, we perform nonlinear cointegration test of Seo (2006) based on threshold vector error correction models.

The remaining of the paper is organized as follows. Section 2 mentions the overview of the literature. Section 3 discusses data. Section 4 presents the methodology and empirical results. Finally, Section 5 concludes.

2. Review of the Literature

Considering government budget constraint, government expenditures are supposed to be financed by increasing taxes, changing the composition of expenditures or raising public debt. However, a shift in the composition of government expenditures, especially when a decrease in investment expenditures or education expenditures is in question, may lead to a slowdown, and has a negative effect on factor productivity. Moreover, a sustainability issue could also arise with regard to an upsurge in public debt. Thus, particularly in the long-run, government spending inevitably leads to a rise in tax burden. In this regard, due to rising budget deficits in the early 1980s, governments implemented tax increases to finance government expenditures, as Barro (1974) suggests. Following Barro (1974), Anderson *et al*. (1986) also conclude that higher spending forces up taxes. Likewise, Akçoraoğlu (1999), Günaydın (2000), Günaydın (2004a), Yamak and Abdioğlu (2012), Akbulut and Yereli (2016) find evidence of increasing taxes as a

consequence of higher spending. Using error correction models; Hondroyiannis and Papapetrou (1996) investigate Greece's fiscal system, Za Saunoris and Payne (2010) analyze government spending of the UK over the period 1955-2009. Both studies conclude that government expenditures are fully capitalized by taxpayer-citizens at the end of the day.

In this regard, examining the fiscal burden of public health expenditures, which is a major component of government expenditures, carries a great importance. However, there is a scarce literature on the considered relationship. For instance, Banthin and Bernard (2006) examine the impact of health expenditures on the taxes of the US economy over the period 1996-2003 by means of panel data analysis and find an upsurge in the burden of health expenditure. From another point of view, Smith (2002) and Lim (2004) conclude that some governments share the burden of taxes on health expenditures with the private sector via health insurance. Furthermore, Maisonneuve and Martins (2013) obtain two crucial findings. First, both health and long-term care drive up public spending. Second, health care expenditures increase mostly by the combined effect of technology, relative prices and exogenous factors such as institutions and economic policies.

Considering the tax effects of health expenditures, it is important to examine the underlying factors of rising health spending to improve tax policy. In this context, the empirical literature on the health expenditures mainly addresses the impact of GDP growth and older population. The past literature using conventional time series and dynamic panel data methods mostly conclude that the rise in GDP and aging increase health care expenditures (Matteo and Matteo, 1998; Dormont and Huber, 2006; Kıymaz *et al*., 2006; López-Casasnovas and Saez, 2007; Breyer *et al*., 2015). On the other hand; several studies employing cross-sectional analysis and linear time series methodology find no substantial evidence supporting that the rising share of older population (Leu, 1986) and GDP (Hansen and King, 1996) lead to an upsurge in health expenditures. Likewise, some recent studies utilizing panel data analysis such as Palangkaraya and Yong (2009) and Richardson and Robertson (1999) also support the finding of negligible relationship between aging and health care expenditures for the OECD countries.

Our study aims to contribute to this restricted literature by employing nonlinear methods to examine the impact of older population on the public health care expenditures. In addition to this, we examine the effects of the change in public health expenditures on the tax system, mainly how spending pressure of health sector affects the tax burden of the economy. More briefly, the contribution of our study is two-fold. First, we examine the issue of health expenditures in a fiscal framework. Second, we fill up the literature gap by employing recent time series techniques which consider nonlinearity to the individual data of the selected OECD countries.

3. Data

Our study analyzes the public health expenditures and effects on the tax system over the period 1965-2012[4] for 13 OECD countries, namely Australia, Austria, Denmark, Finland, Germany, Japan, the Netherlands, Norway, Portugal, Sweden, Turkey, the United Kingdom, the United States, which are selected with regard to data availability. The source and the description of the data are presented in Table 1.

Table 1

Variables and the Source of Data[5]

Variables	Source
pe: Public expenditure on health (% of GDP)[6]	OECD Health Statistics, 2013
age: Population 40^{+} (as a share of total population)[7]	OECD Population Statistics, 2013
tax: Total tax revenue as a percentage of GDP	OECD Revenue Statistics, 2013

As presented in Table 1, we consider 40 years and above as the age group which marks the starting point of the health expenditure risk, referring to a series of studies which indicate that the upwards trend in health expenditures starts in the age group and above, particularly in the case of chronic illnesses and in relation to income level[8].

Prior to the empirical analysis, some descriptive statistics such as skewness, kurtosis and Jarque-Bera results are presented in Table 2. Since the kurtosis values are smaller than 3, all series are small-tailed with the exception of *pe* series of the United Kingdom and Denmark, *tax* series of Australia, Germany and Norway and *age* series of Austria and Turkey.

Table 2

Descriptive Statistics

	pe			age			tax		
	Skewness	Kurtosis	JB	Skewness	Kurtosis	JB	Skewness	Kurtosis	JB
Australia	-0.14	2.32	0.63	0.28	1.50	0.11	-0.68	3.09	0.19
Austria	-0.06	1.62	0.15	1.17	3.05	0.01	-0.09	1.79	0.23
Denmark	1.07	3.73	0.02	0.03	1.71	0.23	-0.67	2.05	0.09
Finland	-0.27	2.72	0.68	0.09	1.49	0.13	-0.49	2.03	0.19

[4] Our study does not cover the period after 2012 since the dataset includes the actual data on submission date.

[5] Contrary to other sample countries, for Turkey, the share of population over age 40 is obtained from Eurostat. Moreover, the missing periods in the OECD Health Statistics for public health expenditure/GDP of Turkey is derived from the databases of the Republic of Turkey Ministry of Health and Social Security Institution together with the study of Emil and Yılmaz (2013).

*[6] Public expenditure on health (% of GDP) is computed by the formula, (total expenditure on health/gdp*public expenditure on health/total expenditure on health)/100.*

[7] The data is computed by the sum of age groups 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-80, 80-84, 85^{+} as a share of total population. Although the literature utilizes the share of population over 65 as a proxy for aging, we use population over 40 since serious illnesses such as diabetics, heart problems appear commonly as from the regarding age group.

[8] For further discussion, please see European Commission (2009).

	pe			age			tax		
	Skewness	Kurtosis	JB	Skewness	Kurtosis	JB	Skewness	Kurtosis	JB
Germany	-0.49	2.56	0.35	0.66	2.40	0.15	-1.29	5.06	0.01
Japan	0.19	2.18	0.45	-0.07	1.63	3.79	-0.84	2.40	0.04
Netherlands	1.56	4.19	0.01	0.25	1.78	0.23	0.17	1.97	0.37
Norway	-0.68	2.38	0.08	0.59	2.13	0.11	-1.69	5.17	0.01
Portugal	0.28	1.73	0.19	0.34	1.86	0.21	-0.52	1.94	0.14
Sweden	-0.39	2.97	0.58	0.06	1.62	0.18	-1.12	2.85	0.01
Turkey	0.25	1.92	0.42	1.73	4.19	0.01	0.56	1.74	0.07
United King.	0.59	3.01	0.22	0.82	2.30	0.05	-0.45	2.85	0.44
United States	0.11	1.98	0.31	0.68	1.92	0.05	0.43	2.48	0.37

Note: JB implies the probabiity value of Jarque-Bera statistic.

Besides, they mostly exhibit leftward skewness due to the positive values. According to the Jarque-Bera test statistics, the null hypothesis of normality is commonly accepted for the series. However, the *pe* series of Denmark, The Netherlands and Norway; *age* series of Austria, Turkey, The United Kingdom and The United States; *tax* series of 6 economies (Sweden, Norway, Denmark, Germany, Japan and Turkey) are found not to be normally distributed with regard to the Jarque-Bera test statistics rejecting null of normality.

4. Methodology and Empirical Results

We employ two models to examine the tax burden of health expenditures in 13 aging economies. The first model analyzes the effect of the rise in 40+ population (age) on public health expenditures (pe). Afterwards, in the second model we investigate the tax effects of increasing health expenditures. In the testing procedure, we consider the potential non-linearity of the series with regard to the fluctuations in both government expenditures and taxes as a consequence of changing fiscal policy in the era of crises.

4.1. Unit Root Test

Our methodology leans on several stages which begin with the unit root test of Kapetanios *et al*. (2003) which extends the conventional ADF unit root test. Kapetanios *et al*. (2003), herafter KSS, develop a testing procedure to examine the existence of non-stationarity against nonlinear stationary exponential smooth transition autoregressive (ESTAR) process:

$$\Delta y_t = \gamma y_{t-1}\left[1-\exp\left(-\theta y_{t-d}^2\right)\right]+\varepsilon_t \qquad (1)$$

where: θ is the transition parameter which controls the speed of transition.

The null hypothesis of KSS test is $H_0:\theta=0$ against the alternative of $H_1:\theta>0$. However, there is an identification problem of equation (1) under the null hypothesis due to γ parameter. To overcome the problem of unidentified γ, Kapetanios *et al*. (2003) develop a t-type test statistic by utilizing the Taylor approximation of (1) in the following form:

$$\Delta y_t = \delta y_{t-1}^3 + e_t \quad (2)$$

$$\Delta y_t = \sum_{j=1}^{p} \rho_j \Delta y_{t-j} + \delta y_{t-1}^3 + e_t \quad (3)$$

The test statistic is obtained by testing the null of $H_0 : \delta = 0$ against the alternative of $H_1 : \delta$ >1 in regressions (2) and (3) and compared to the critical values derived by Kapetanios *et al*. (2003) via simulations. According to the results in Table 2, we cannot reject the null of unit root for all countries in our sample. Thus, in the succeeding step of the methodology, we will examine the long-run behaviour of the series by means of nonlinear cointegration analysis proposed by Seo (2006).

Table 3

The KSS Test Results

	t_{pe}		t_{age}	t_{tax}
Australia	-2.01		-1.31	-1.23
Austria	-1.50		-1.27	-1.19
Denmark	-1.14		-2.85	-1.13
Finland	-1.58		-3.14	-1.17
Germany	-1.45		-1.36	-1.78
Japan	-1.13		-1.15	-1.09
Netherlands	-1.07		-1.73	-1.26
Norway	-1.18		-1.24	-1.39
Portugal	-1.27		-1.09	-1.26
Sweden	-1.12		-2.23	-1.11
Turkey	-1.54		-1.07	-1.26
United Kingdom	-1.17		-1.14	-2.15
United States	-1.36		-1.20	-1.34

Note: For the asymptotic critical values, see Kapetanios et al. (2003).

4.2. Cointegration Analysis

Apart from conventional cointegration tests, Seo (2006) proposes a two step approach which tests both long-run equilibrium and short-run dynamics. This testing procedure examines the linear no cointegration null hypothesis in a threshold vector error correction model (TVECM) in the following form

$$\Phi(L)\Delta x_t = \alpha_1 z_{t-1} I(z_{t-1} \le \gamma_1) + \alpha_2 z_{t-1} I(z_{t-1} \succ \gamma_2) + \mu + \varepsilon_t \quad (4)$$

where: $\Phi(L)$ is a q[th] order polynomial in the lag operator which is defined as $\Phi(L) = I - \Phi_1 L^1 - \ldots - \Phi_q L^q$.

On the other hand, z_t defines the vector of error correction terms, α_1 and α_2 identify the speed of adjustment and γ_1, γ_2 are the threshold parameters which satisfy the

condition of $\gamma_1 \leq \gamma_2$. Seo (2006) tests the null of linear no cointegration $(H_0 : \alpha_1 = \alpha_2 = 0)$ via two- regime band TVECM in (4). The test statistic, namely supremum of Wald statistic (SupW) is compared to the critical values which are obtained by Monte Carlo simulation of 100,000 replications with the sample size of 100,000 by Seo (2006).

We summarize Seo (2006) cointegration test results in Table 4. According to the results, we find evidence of long-run relationship between aging and public health expenditures for all countries in our sample. However, the null of no cointegration cannot be rejected for Japan, Sweden and the US in model 2. More briefly, we conclude that public health expenditures do not lead to increase the tax burden in those economies.

Table 4

The Seo (2006) Cointegration Test Results

	supW	Threshold parameter (L)	Threshold parameter (H)
Model 1 (pe-age)			
Australia	18.44*	3.69	4.8769
Austria	18.59*	3.37	6.07
Denmark	33.10*	7.57	8.15
Finland	26.36*	4.08	4.98
Germany	18.79*	6.16	8.05
Japan	23.98*	4.07	4.68
Netherlands	25.42*	5.28	5.48
Norway	18.59*	-6.82	-5.12
Portugal	21.66*	2.58	6.54
Sweden	35.72*	7.14	7.34
Turkey	17.07**	0.73	1.03
United Kingdom	15.41**	-6.2	-5.49
United States	17.38*	4.18	6.56
Model 2 (tax-pe)			
Australia	30.52*	1.1	2.6
Austria	11.27***	-6.77	-6.55
Denmark	14.51**	-7.3	-4.6
Finland	20.15*	-7.8	-6.48
Germany	14.42**	-3.9	-2.3
Japan	9.14	-2.23	-1.52
Netherlands	27.40*	-6.9	-5.93
Norway	18.59*	-6.82	-5.12
Portugal	25.43*	-4.5	-4.19
Sweden	6.18	-6.52	-5.77
Turkey	11.14***	-3.91	-3.48
United Kingdom	17.03**	4.57	5.06
United States	3.36	-4.47	-0.8

*Note: i) For the critical values for SupW test, see Seo (2006). ii) *, ** and *** indicate %1, %5 and %10 significance levels, respectively.*

After the cointegration analysis, we also report the underlying VECMs to examine the short run dynamics in Model 1 and Model 2.

Table 5

Estimation Results of TVECMs

	constant	pe_{t-1}	age_{t-1}	EC_{t-1}	Threshold value
Model 1 (Dependent variable: pe)					
Australia	-1.15 (0.28) -0.06 (0.29)	3.07*** (0.003) 0.01 (0.91)	0.41* (0.01) 0.23* (0.01)	-1.43*** (0.07) -0.16*** (0.08)	-0.65
Austria	-2.94 (0.24) 0.22** (0.03)	-0.02 (0.99) -0.06 (0.70)	0.16*** (0.06) 0.26** (0.03)	-1.09** (0.03) -0.04** (0.04)	-2.28
Denmark	0.16 (0.45) 0.51* (0.01)	-0.23 (0.33) 0.28 (0.22)	0.31** (0.04) 0.27*** (0.07)	-0.07*** (0.09) -1.03* (0.01)	-0.06
Finland	0.04** (0.64) 0.05** (0.88)	0.31*** (0.07) 0.99* (0.00)	0.15 (0.44) 0.36* (0.00)	-0.14*** (0.10) -1.510 (0.00)	0.79
Germany	0.29 (0.18) 0.01* (0.97)	0.76* (0.00) -0.01 (0.54)	0.15** (0.05) 0.09*** (0.06)	-0.23*** (0.09) -0.11** (0.02)	-0.45
Japan	0.12 (0.26) 1.58 (0.16)	0.22 (0.21) 10.23 (0.12)	0.11*** (0.09) 0.09*** (0.07)	-0.13 (0.14) -9.18 (0.19)	0.25
Netherlands	-0.09 (0.56) 27.37*** (0.10)	0.30 (0.20) 2.15 (0.15)	0.02*** (0.09) 0.45*** (0.10)	-0.20* (0.01) -2.61** (0.04)	-0.04
Norway	0.21* (0.01) -0.27 (0.21)	0.02 (0.91) 0.45** (0.02)	0.17*** (0.06) -0.12 (0.13)	-0.01*** (0.07) -0.32** (0.02)	0.15
Portugal	-0.53* (0.00) 0.76*** (0.08)	0.07 (0.69) -0.09 (0.72)	0.41* (0.01) -0.98 (0.31)	-0.40* (0.00) -0.11** (0.40)	-0.53
Sweden	-0.11 (0.37) 0.47* (0.00)	0.08 (0.69) -0.62** (0.03)	0.19** (0.05) 0.18* (0.00)	-0.35*** (0.06) -0.11** (0.04)	-0.06
Turkey	0.09 (0.57) -0.23 (0.43)	-0.28 (0.28) 0.49** (0.03)	0.29** (0.04) 0.26*** (0.06)	-0.15*** (0.08) -0.16* (0.01)	-0.08
United Kingdom	-0.17 (0.86) 0.07*** (0.10)	0.44 (0.75) 0.17 (0.34)	-0.01 (0.83) 0.09 ***(0.07)	-0.13*** (0.08) -0.01*** (0.09)	-1.3
United States	3.11 (0.96) 4.97* (0.00)	0.44* (0.00) -3.44** (0.02)	18.55** (0.03) 0.32* (0.01)	-0.04** (0.02) -3.30** (0.03)	1.09
Model 2 (Dependent variable: tax)					
	constant	pe_{t-1}	tax_{t-1}	EC_{t-1}	Threshold value
Australia	0.22 (0.18) -4.43* (0.008)	0.49** (0.04) 0.13*** (0.09)	-0.41** (0.03) 0.68 (0.32)	-0.50*** (0.07) -3.06*** (0.09)	0.7
Austria	-4.18** (0.03) 0.43 (0.10)	0.76*** (0.07) 0.47** (0.05)	-0.64 (0.13) -0.22 (0.14)	-2.81** (0.02) -0.18** (0.03)	-0.8
Denmark	0.83*** (0.08) -0.73 (0.16)	-0.91 (0.31) 1.96** (0.02)	0.38*** (0.07) -0.07 (0.71)	-0.71*** (0.10) -1.67** (0.02)	-0.1
Finland	0.06 (0.88) -0.02 (0.12)	0.01*** (0.07) 0.01 (0.89)	0.81* (0.00) 1.54* (0.00)	-1.23** (0.04) -0.05*** (0.06)	0.79
Germany	-7.92*** (0.09) 0.22*** (0.10)	-0.62 (0.79) -0.61 (0.17)	-3.02* (0.00) -0.28*** (0.06)	-7.81** (0.04) -0.21* (0.02)	-1
Japan	0.22 (0.30) -0.05 (0.91)	-1.44** (0.02) 0.06 (0.86)	0.44** (0.05) -0.27 (0.31)	-0.06 (0.82) -0.11 (0.79)	0.5
Netherlands	22.11* (0.00)	2.77 (0.64)	0.96*** (0.10)	17.80* (0.00)	-1.1

	constant	pe_{t-1}	age_{t-1}	EC_{t-1}	Threshold value
	-0.11 (0.58)	0.31 (0.56)	-0.03 (0.82)	-0.03*** (0.08)	
Norway	15.33* (0.01) 0.12 (0.40)	8.24** (0.03) 0.61** (0.03)	-0.42 (0.30) 0.11 (0.51)	-6.21** (0.03) -0.03*** (0.06)	-1.3
Portugal	3.61 (0.33) 0.71* (0.00)	-3.37 (0.26) -0.03 (0.95)	-1.22** (0.04) 0.08 (0.96)	3.14** (0.03) -0.27*** (0.08)	-0.8
Sweden	-6.27** (0.02) 0.73 (0.44)	0.10 (0.98) -0.03 (0.98)	0.36 (0.53) 0.02 (0.88)	6.39** (0.04) -0.21 (0.71)	-0.2
Turkey	1.23*** (0.09) -0.01 (0.99)	-3.19 (0.14) 3.14 (0.11)	0.19 (0.49) -0.23 (0.19)	-1.05** (0.01) -0.30*** (0.10)	-0.3
United Kingdom	0.09* (0.00) 0.08 (0.32)	0.01 (0.94) 0.01 (0.76)	0.61* (0.00) -1.13 (0.63)	0.07*** (0.04) 0.02** (0.03)	0.83
United States	0.19 (0.97) 0.18 (0.31)	-1.24 (0.67) -1.39 (0.11)	-1.64* (0.00) 0.14 (0.36)	0.50*** (0.09) -0.04 (0.60)	-2.9

*Notes: i) The rows in each column show lower and upper regimes, respectively. The lower (upper) regime arises below (above) the threshold value. ii) *, ** and *** indicate %1, %5 and %10 significance levels, respectively. iii) Lag selection is based on pooled Akaike Information Criteria.*

TVECM estimation results show that the coefficients on the lagged values of aging in Model 1 which explains public health expenditures are mostly significant with positive values. Furthermore, the error correction terms are negative and significant in both lower and upper regimes. On the other hand; the lagged coefficients of public health expenditure which determines tax burden in Model 2 are rarely found to be significant for the economies in question. Moreover, we find no evidence of short-run adjustments to the long-run equilibrium with regard to the insignificant coefficients on error correction terms for Japan and in upper regime of Sweden and The United States. To sum up, we conclude that public health expenditures do not create tax burden for those countries in short run as well as the absence of long-run relationship with regard to cointegration results.

As motivation of our study, we expected that rising health expenditures in the long run as a consequence of technological progress, higher income level and aging inevitably would lead to tax burden in the OECD countries. According to the empirical results, we find that the findings are substantially in parallel with our expectations for the majority of the sample countries. However, we cannot find support regarding the impact of public health expenditures on tax burden for Japan, Sweden and the US. This finding could be interpreted with regard to the country specific characteristics. For instance, the share of public health expenditures in the total government spending is considerably high in Sweden, which is a social welfare economy. As a consequence of this structural circumstance, the pressure of health expenditures on taxes is restricted. On the other hand, for the US high out-of-pocket health spending restrains the rise in tax burden led by public health expenditures. Furthermore, in Japan the case is in accordance with the fiscal policy regarding high budget deficits. More clearly; government raises spending by moving the budget towards deficits without increasing tax burden.

Finally, our results are not only coherent with our expectations, but also with the literature to a large extent. The finding which supports the aging as a major determinant of public health expenditures is consistent with Matteo and Matteo (1998), Dormont and Huber (2006), Kıymaz *et al*. (2006), López-Casasnovas and Saez (2007), Breyer *et al*.

(2015). Moreover, our results which reveal the effect of public health expenditures on taxation are relevant with the key studies as Barro (1974) and Anderson *et al*. (1986).

Conclusion

Population projections for 2050 suggest that the share of the population aged 65 or above in total population is expected to almost double in a number of countries, reaching about 30 percent. This trend, together with relative prices, technology, and public policies, will be a main driver of the relatively sharper upward movement in public health expenditures.

The rise in public spending pertaining to health and care for the elderly will put a pressure on tax burden, as the present study has validated the significance of such pressure for all sample countries with the exception of Japan, Sweden and the US. This pressure on public finance raised from borrowing at the limits of the fiscal sustainability will cause an increase in tax burden at variable rates in different countries.

To sum up, by rising government spending, public health expenditure leads to tax increases globally. As a policy implication, cost efficient policies resulting from the health research in curative treatments and preventive health care programs could prevent the fiscal deterioration. In this context, creating policies in health sector which relieve the pressure of increasing public health expenditures on tax system by enhancing new technology, and productivity should be considered by the public sector.

Apart from ageing of the population, factors such as relative prices, technology, public policies and macroeconomic projections including economic growth, unemployment rate and government debt will further incur fiscal pressure on taxes. This risk will prove even stronger in the case of developing countries with inefficient policymaking process and budgeting systems. Thus, examining those underlying factors particularly for developing economies would be worthwhile and fruitful area for future research.

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