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Tax revenues and aging in ex-communist EU countries[1]

***Mihai Mutascu*[2], *Maciej Cieślukowski*[3]**

Abstract: The paper explores the relationship between tax revenues and aging in the case of 10 ex-communist EU countries, for the period 1995–2012, by using a panel model approach. The main finding shows that the ageing has a significant and positive impact on tax revenues. In these ex-communist countries, the persons are more interested in the redistribution. On the other hand, there are high revenue amounts for older persons and a low degree of meritocracy. Both aspects put pressure on public expenditures and required additional financial needs for the government.

Keywords: tax revenues, determinants, aging, ex-communist countries, aging effects.

JEL codes: H20, Q56, C23, C26.

Introduction

Population ageing is one of the most important topics for the social science in the last decades with complex implications in the area of economics also. The most affected countries by this tendency are European countries, especially the ex-communist states. Ageing, as a demographic element, has significant implications for the economy with extended effects in the field of taxation. In this way, illustrating the classical determinants of tax revenues, Lago-Peñas and Lago-Peñas [2008] include the age of the population in the group of socio-demographic characteristics, jointly with gender, marital status, education, employment status, religion and social class.

Given this relevance of the ageing phenomenon to economic tax literature, the main aim of the paper is to investigate whether the ageing is associated with tax revenues in the case of ten ex-communist EU countries in the peri-

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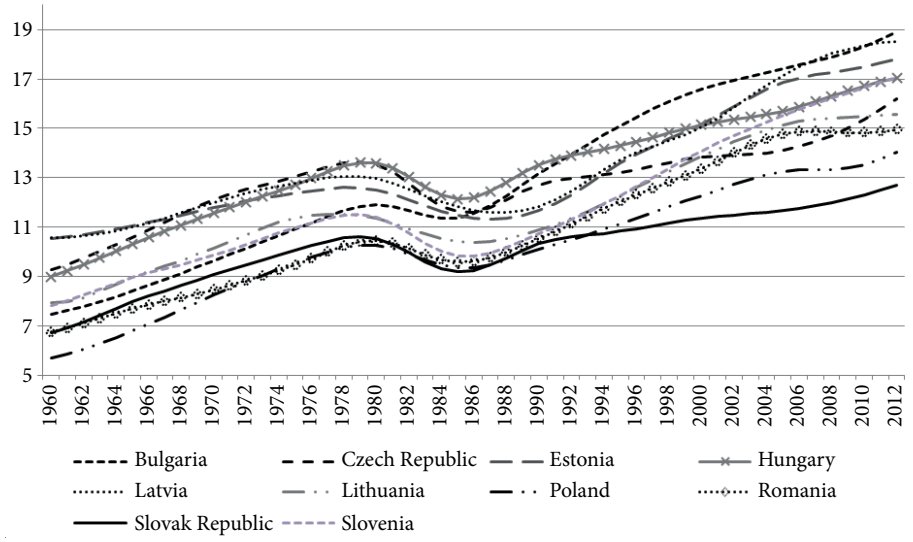
od 1995–2012. This group of states arouse additional interest as they passed through two different political regime periods: one autocratic and the other democratic. In this way, Farkas [2011] emphasizes that such countries have a set of common characteristics: "the lack of capital, weak civil society and the impact of the European Union and other international organisations influencing the new member states" [p. 15].

Another common feature of those countries is a similar course of the share of registered population aged 65 and above in the total population, from 1960 to 2012, as in Figure.



The population aged 65 and above as a percentage of total population in the case of ex-communist EU countries for the period 1960–2012
Source: [World Bank 2014]

The figure above illustrates two periods with an ascending trend of population aged 65 and above as a percentage of the total population in the case of ex-communist EU countries: firstly until 1979–1980, and secondly since 1986. The second interval of time registers a significant increase in the population aged 65 and above in total population especially after 1990, covering all democratic period of the countries considered.

The main novelty of the paper in the field literature is the fact that the results are the first ones obtained for ex-communist EU countries regarding the "tax revenues-ageing" connection. On the other hand, the study is one of the first analysis that use, as a tool of investigation, a panel model approach, testing also for non-linearity of the considered nexus between tax revenues and ageing.

The rest of the paper is structured as follows: Section 1 presents a general literature framework; Section 2 illustrates the data and methodology; whilst Section 3 describes the results. Finally, Section 4 concludes the study.

1. Literature review

According to Peñas and Lago-Peñas [2008], ageing is one of the most important socio-demographic classic tax determinants. The other groups of tax factors include political and social attitudes, the fiscal parameters and the contextual determinants. The political and social attitudes are related to the trust in courts, legal system, in politicians, the level of democracy , national pride, social capital, perception of corruption and voting behaviour. The fiscal parameters include tax rates, fine rate, audit probability, risk aversion and personal income, whilst the contextual determinants are the extent of direct democracy, language fragmentation and the existence of regional divisions.

Literature regarding the "tax-ageing" nexus is not so prolific. Even so, it reveals contradictory results concerning the relationship between tax revenues and ageing. One strand of research shows that the ageing has a positive impact on tax revenues, whilst the second claims a negative correlation between them.

Adding significant findings to the first group of contributions, Mincer [1970] shows that the older labour force increases the level of tax revenues as the income level of older taxpayers is greater than the income level of younger persons. In other words, the incomes of older workers are greater than the incomes of younger people as result of professional experience and maturity. As income is one of the most important parts of the tax-base, the older people's income tax-base and tax payments are superior to the tax-base and taxes of young workers. He also explains that the age-earning characteristics register an upward tendency over a large period of the life cycle. On the other hand, when the percentage of the old population goes down, the percentage of the elderly (65 years and above) to working people (15–64) in the total population increases, tax revenue shows a descending trend. Visco [2001] finds similar results, but with different arguments . He states that the extension of an ageing population generates more pressure on public expenditure as a result of additional social needs provided by the welfare state related to the ageing population. In this case supplementary tax revenues should finance the redistribution amongst the generations and all additional social needs. The increase of tax revenue represents a direct effect of a public expenditure rise under the pressure of the ageing population (i.e., when the percentage of elderly people in the total population increases, the corresponding public expenditure increases and generates a need for additional tax revenue).

The second group of research reveals the contrary: the increase of ageing in the population results in a decrease in tax revenue. On the one hand, as

Goudswaard and Van de Kar [1994] note, when the ratio of elderly (65+) to working people (15–64) increases the tax revenues decrease because the number of taxpayers is reduced. More precisely the tax base contracts as results of the decrease in the number of taxpayers. Thus, if the segment of an ageing population is greater than the segment of young population, the older people will pay fewer taxes by comparison with young taxpayers, because their tax-base reduces as result of retirement.

According to Razin, Sadka, and Swagel [2002], the same effect is obtained but through the voting process. Firstly, the taxes tend to be higher because the ageing voters vote for additional financing for social needs. Furthermore, the tax revenues will collapse due to reluctant behaviour regarding the tax payments of the young taxpayers. These arguments are also related to Kirchler's [2007] explanations, which states that different perceptions regarding the tax payments exist between old and young people. If the old persons are more responsible in respect to taxation (i.e. they have a high level of tax compliance), the younger generations are less responsible (i.e. they reveal a low level of tax compliance). Thus, the older persons will pay "more taxes" than the young taxpayers.

Finally, Brett [2012] analyzes the effects of population ageing on optimal redistributive taxes in an overlapping generation model, having as a starting point the results of Ordover and Phelps [1979]. The optimal tax concept is related to a nonlinear approach which has as its starting points the production and utility functions. The author shows that a decrease in the rate of population growth leads to an ageing population, which puts pressure on the relative price of consumption per person in retirement. Given this pressure the price of consumption rises and tends to reduce the level of consumption. Simultaneously the scholar also shows that, when the population becomes older, wage rate increases and the implicit marginal income tax rates remain unchanged. As a consequence, the optimal marginal income tax rates are independent of the rate of population growth.

Nearly al these approaches follow either theoretical modelling or econometric tools by especially using linear estimation techniques.

2. Methodology and data

Taking into account the main literature the investigation of the relationship between tax revenues and ageing in the case of the ten ex-communist EU countries for the period 1995–2012 (data available period) is based on the hypothesis below:

H: *Ageing has a significant impact on government tax revenues, being an important determinant of macroeconomic policies, especially in taxation policy.*

Our balanced panel sample includes, for the period 1995–2012, the following ex-communist EU countries: Bulgaria, the Czech Republic, Estonia, Hungary,

Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia (Croatia has not been targeted as this country integrated in EU later).

The dependent variable is represented by collected tax revenues per capita (τ), which denotes the level of tax revenues collected by central government in US dollars. This variable includes all type of taxes and better captures the source of the whole financial needs of ageing, as these are divided per capita and covered by both personal and company taxpayers.

The independent interest variable is the ageing (λ), which is measured as the population aged 65 and above as a percentage of the total population.

In order to isolate the effect of the interest variable, several control variables have also been considered, following the methodology of Mutascu [2014]. The first group includes variables inspired by classic tax literature, such as: the gross domestic product (GDP), the size of the industrial sector, the size of the agricultural sector and the size of the service sector. GDP controls the size of the economy, being expressed in millions of US dollars. It is expected to have a positive effect on tax revenues per capita [Katircioglu 2010]. The size of the industrial sector, the size of the agricultural sector and the size of the service sector are measured as a percentage of GDP and capture the structure of the economy, with significant impact on the dependent variable [Agbeyegbe, Stotsky, and WoldeMariam 2006]. We expect that the industrial and service sectors have a positive impact on tax revenues, whilst the agricultural sector has a negative one.

The second group of control variables is related to the appropriate macroeconomic policy area and is represented by the government final consumption expenditures and the net inflow of foreign direct investment (FDI). The first variable quantifies the government final consumption expenditures as a percentage of GDP, being expected to have a positive influence on tax inputs [Taha and Loganathan 2008]. FDI measures the difference between inward foreign direct investment and outward foreign direct investment as a percentage of GDP. Many studies point-out its positive impact on tax revenues [e.g., Wildasin 2003].

The last set of control determinants concerns robustness. We consider here the following determinants: the government effectiveness, level of corruption and political stability. The government effectiveness denotes the government quality and "captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation and the credibility of the government's commitment to such policies" [World Bank 2014]. The value –2.5 shows a weak governance performance, whilst 2.5 – a strong one. The impact of government effectiveness on tax revenues is expected to be positive, as Lisi [2011] notes. The level of corruption is expressed in percentile rank and reveals the intensity of corruption, from 0 (high level) to 100 (low level). This dimension does not offer any information about tax compliance. According

to Imam and Jacobs [2007], a negative impact of corruption on tax revenues is expected. The political stability denotes the number of years since the change of the most recent regime or the end of the transition period defined by the lack of stable political institutions. This dimension has an ambiguous impact on tax revenues [Estrada, Mutascu, and Tiwari 2013].

The tax revenues per capita and GDP are treated as elasticities, with natural log form, excepting the regressors already expressed in percentage and the political stability, which does not have strict positive values. The sources of data and the descriptive statistics of variables are illustrated in Tables 1 and 2 in the Appendix.

The main function is:

$$\ln(\tau) = f(\lambda), \tag{1}$$

where:

τ – the amount of tax revenues per capita in U.S. dollars,

λ – the population aged 65 and above as percentage of the total population.

The extended panel-model is as follows:

$$\ln(\tau)_{it} = \alpha + \alpha_1 \lambda_{it} + \sum_{k=1}^{n} \beta_k X_{k,it} + \mu_i + \nu_t + \varepsilon_{it}, \tag{2}$$

where:

α – the intercept,

α_1 – the slope of interest variable,

β_k – coefficient of control independent variable k by n type,

X – control variables,

μ_i – stands for country fixed effects,

υ_t – time-specific effect that checks for unaccounted common time-varying factors,

i – country,

t – time,

ε_{it} – the error term.

The main function is also tested for polynomial non-linearity by using the wald-test, partial F-test and taking into account the significance of the resultant coefficients. Furthermore, the first estimations are performed in several scenarios, with different factorial determinants, by using the OLS panel regressions. At the same time, the multi-coliniarity implications of independent variables are also investigated.

Secondly, we deal with the homogeneity of the panel. As the panel-data model may have heterogeneity in the data, we test this property by analyzing both cases of fixed and random panel-model effects, through the F-test and

Hausman-test. The random effects estimation requires the number of cross-sections to be greater than the number of coefficients. As in our case the number of cross-sections is equal to the number of coefficients The random model is not employed.

The last potential issue in estimations is the endogeneity, especially due to the reverse causality of the interest variable. We deal with this issue by following the IV model (Instrumental Variables regression, also known as Two-Stage Least-Squares estimator). Unfortunately, this estimation is not consistent under heteroskedasticity disturbance. In this case, as Baum, Schaffer, and Stillman [2003] note, "if heteroskedasticity is present, the GMM estimator is more efficient than the simple IV estimator, whereas if heteroskedasticity is not present, the GMM estimator is no worse asymptotically than the IV estimator" [p. 11]. The Pagan-Hall general test statistic is calculated to illustrate evidence of the heteroskedasticity in IV regression, whilst the Wu-Hausman F-test shows if the regressors are or not exogenous in IV regression.

3. Results

The first outputs in Table 3 in the Appendix, reveal that in the case of the naive model 1, the interest variable (λ) is significant and positively correlated with ln of the dependent variable (τ). Further, the wald-test for non-linearity of the main function, entering the square of the interest variable, shows that we cannot reject the result that the coefficient of the square interest regressor is zero. Additionally, the same output is obtained by performing the partial F-test for the coefficients of the block "interest variable and the square of interest variable". Based on the value 0.04 of partial F-test (p-value = 0.842), in Table 3 and in the Appendix, we cannot reject the null hypothesis (H0 = the coefficients of both interest variables are 0).

Thus, for the whole analysis, we assume that the main function is linear. This conclusion is reinforced by the insignificance of all coefficients of the non-linear model 2.

Entering the control variables progressively, the main output shows that, in the case of OLS models 3 and 4, the coefficients of the interest variable are still significant, having the same positive impact on ln of tax revenues per capita as in the naïve scenarios. Between the control variables, ln of GDP, size of the industrial sector, size of the agricultural sector, control of corruption and political stability are significant. Only the size of the agricultural sector is negative , whilst the rest of the determinants are positively correlated with the dependent variable. The rest of the control determinants remain insignificant.

In the case of the complete OLS model 4, the variance inflation factor test results (VIF-test) in Table 4 in the Appendix, show there is not any significant

multicoliniarity issue between the regressors, as all test levels are less that the critical level 4 [O'Brien, 2007], at limit for the size of service sector and government effectiveness.

Furthermore, in the fixed-effects model 5 the homogeneity of the considered panel is tested. The F-test illustrates that this fixed-model model 5 is more appropriate for our analysis than the OLS model 4. In this case, the main finding shows that the interest variable is still significant and positive as in the previous OLS estimations.

The last step of our panel investigation is the endogeneity issue. This can be caused either by omitted variables and measurement error or by the reverse causality, especially of the interest variable. In order to deal with this, a TSLS model 6 is performed, using as instruments the lags of the interest-instrumented variable. The Wu-Hausman F-test for endogeneity reveals that the null of "the regressor is exogenous" and cannot be rejected. The last test is for the presence of heteroskedasticity. The output of the Pagan-Hall general test statistic, in model 6, clearly shows that the null of "disturbance is homoskedastic" and cannot be rejected. Thus, the disturbance of model 6 is homoskedastic and the TSLS model 6 is more efficient than any GMM estimations [Baum, Schaffer, and Stillman 2003]. As a consequence, the TSLS model 6 is selected for the final analysis of the relationship between ln of tax revenues per capita and the population aged 65 and above.

The main output in model 6 indicates that the interest variable λ is significant and has a positive impact on ln of tax revenues per capita. In other words, when the level of the older population increases a as percentage of the total population, the level of collected tax revenues increases also. The same positive sign has several significant control variables, such as: ln of GDP, size of the industrial sector, control of corruption and political stability. The size of the agricultural sector remains significant, but negatively correlated with dependent variable τ. The rest of control variables are non-conclusive.

Our findings confirm the results of Mincer [1970] and Visco [2001], but are in contradiction to the outputs obtained by Goudswaard and Van de Kar [1994], Razin, Sadka, and Swagel [2002] and Brett [2012]. The explanation is that the considered sample includes an ex-communist area, more interested in redistribution, with strong economic disequilibrium, high revenue amounts for older persons and a low degree of meritocracy. Moreover, these countries have a common and special "model" of governance, as Farkas [2011] notes. The author highlights three main common characteristics: (i) a low level of capital inflow, (ii) a weak civil society, and (iii) the strong impact of the European Union institutions on economic and social environment. All these factors, plus the international migration to other countries , generate over time a strong disparity between the number of older and the number of younger people, with a negative impact on government inputs (i.e. the number of taxpayers becomes lower than the number of retired people).

Conclusions

Ageing is a new and important determinant of tax revenues, even if the literature in the field is not so prolific. In the case of the ten ex-communist EU countries, for the period 1995–2012, the main findings show that ageing has a significant and positive influence on tax revenues.

In ex-communist countries the people are more interested in the redistribution of revenues, the memories of the "left political period" are still fresh in the minds, especially in the older persons. On the other hand, many of these countries are still contributary to gerontocracy, the older persons having a high level of revenue. Both issues put pressure on public expenditure and the additional financial needs imposed on the government.

Regarding the policy implications in these countries the governments should follow a mixed policy strategy. In the tax policy area it is a requirement that the maximizing of tax revenue should be achieved only through a coherent demographic policy by improving the birth rate.

This investigation focuses exclusively on the impact of ageing on the area of taxation but can be easily extended to the government spending component of fiscal policy. This topic would be a good topic for further research.

Appendix

Table 1. The sources of data

Variable	Source
Tax revenues per capita (US dollars)	Calculation based on the level of tax revenues as percentage of GDP, and GDP per capita, offered by World Bank online database, 2014
Population of age 65 and above (percentage of total population)	World Bank online database, 2014
GDP (US dollars)	World Bank online database, 2014
Size of the industrial sector (percentage of GDP)	World Bank online database, 2014
Size of the agricultural sector (percentage of GDP)	World Bank online database, 2014
Size of the service sector (percentage of GDP)	World Bank online database, 2014
Government final consumption expenditure (percentage of GDP)	World Bank online database, 2014
FDI (percentage of GDP)	World Bank online database, 2014
Government effectiveness (percentile rank)	World Bank online database, 2014
Control of corruption (percentile rank)	World Bank online database, 2014
Political stability (years)	Polity™ IV Project Political Regime Characteristics and Transitions, 1800–2012 Dataset

Table 2. Descriptive statistics of variables

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
Tax revenues per capita (US dollars)	1832.84	1447.437	6294.514	242.3813	1247.799	180
Population of age 65 and above (percentage of total population)	0.148633	0.148479	0.194275	0.111419	0.019492	180
GDP (US dollars)	7.75E+10	4.21E+10	5.29E+11	3.78E+09	9.84E+10	180
Size of theindustrial sector (percentage of GDP)	0.329469	0.328603	0.499482	0.215758	0.048456	180
Size of theagricultural sector (percentage of GDP)	0.060759	0.046032	0.249472	0.021786	0.040252	180
Size of the service sector (percentage of GDP)	0.619971	0.628083	0.765597	0.319488	0.072221	180
Government final consumption expenditure (percentage of GDP)	0.226797	0.196361	0.987734	0.111273	0.127115	180
FDI (percentage of GDP)	0.054652	0.041118	0.518958	–0.16418	0.066903	180
Government effectiveness (percentile rank)	0.691311	0.732174	0.897874	0.282927	0.13443	180
Control of corruption (percentile rank)	0.638965	0.648752	0.89757	0.239244	0.121784	180
Political stability (years)	11.13889	11	22	0	5.603036	180

Table 3. Empirical results of panel regressions

Dependent variable: ln tax revenues per capita – ln(τ)						
Independent variables	**Model**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Constant	5.909*** (0.422)	7.143** (2.876)	–0.263*** (0.038)	1.601* (0.906)	–17.739** (0.599)	1.292 (0.988)
Population of age 65 and above (λ)	9.097*** (2.821)	–7.705 (38.835)	12.255*** (1.648)	3.623** (1.467)	2.110*** (0.503)	4.733*** (1.769)
Square of population of age 65 and above (λ^2)		56.223 (129.59)				
Ln GDP			0.193*** (0.030)	0.061** (0.026)	1.014*** (0.025)	0.066** (0.028)
Size of the industrial sector			3.668*** (1.168)	2.893** (0.831)	0.286 (0.211)	2.935*** (0.852)
Size of the agricultural sector			–11.684*** (1.055)	–4.486*** (0.943)	–0.853*** (0.241)	–4.544*** (0.985)
Size of the service sector			0.751 (0.838)	0.746 (0.605)	–0.044 (0.142)	0.733 (0.621)
Government final consumption expenditure				0.066 (0.184)	0.037 (0.045)	0.106 (0.192)
FDI				0.093 (0.329)	0.185** (0.081)	0.072 (0.337)
Government effectiveness				0.451 (0.321)	–0.071 (0.094)	0.487 (0.336)

Control of corruption				2.451*** (0.325)	–0.023 (0.094)	2.432*** (0.343)
Political stability				0.051*** (0.005)	–0.009*** (0.599)	0.050*** (0.006)
Type of estimation	PLS naive	PLS naive	PLS	PLS	FE	TSLS
Model summary						
R–squared	0.055	0.056	0.720	0.865	0.993	0.859
T–statistic of wald–test for square of interest variable "λ"		0.433 Prob.= 0.664				
Partial F–test		0.04 Prob.= 0.842				
F–test for fixed effects					350.25 Prob.= 0.000	
Pagan–Hall general test statistic						9.646 Prob.= 0.472
Wu–Hausman F–test						0.334 Prob.= 0.564

(a) (…) denotes the standard error;
(b) PLS represents panel least squares;
(c) FE means fixed effects;
(d) TSLS denotes Two-Stage Least-Squares regression;
(e) ***, **, and * denote significance at 1, 5 and 10 % level of significance, respectively.

Table 4. Variance inflation factor test results

Variable	VIF	1/VIF
Population of age 65 and above	1.8	0.55412
Ln GDP	1.99	0.50282
Size of the industrial sector	3.58	0.27932
Size of the agricultural sector	3.18	0.31428
Size of the service sector	4.22	0.23687
Government final consumption expenditure	1.21	0.82457
FDI	1.07	0.93197
Government effectiveness	4.13	0.24239
Control of corruption	3.46	0.28918
Political stability	2.41	0.41492
Mean VIF	2.71	

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*** Polity™ IV Project Political Regime Characteristics and Transitions, 1800–2012 Dataset.

*** World Bank online dataset 2014.

Aims and Scope

Economics and Business Review is the successor to the Poznań University of Economics Review which was published by the Poznań University of Economics Press in 2001–2014. The Economics and Business Review is a quarterly journal focusing on theoretical and applied research work in the fields of economics, management and finance. The Review welcomes the submission of articles for publication dealing with micro, mezzo and macro issues. All texts are double-blind assessed by independent reviewers prior to acceptance.

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