ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 63 206 Number 6, 2015
http://dx.doi.org/10.11118/actaun201563061913

TAX COMPETITION AND ITS CONSEQUENCES FOR TAX REVENUE STRUCTURE IN DEVELOPED COUNTRIES: EMPIRICAL EVIDENCE USING PANEL COINTEGRATION APPROACH

Ján Huňady[1], Marta Orviská[1]

[1] Department of Finance and Accounting, Faculty of Economics, Matej Bel in University Banská Bystrica, Národná 12, 974 01 Banská Bystrica, Slovak Republic

Abstract

HUŇADY JÁN, ORVISKÁ MARTA. 2015. Tax Competition and its Consequences for Tax Revenue Structure in Developed Countries: Empirical Evidence Using Panel Cointegration Approach. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 63(6): 1913–1921.

The paper examines the long run changes in the tax revenue structure in developed countries. We are particularly focused on the testing of a potential shift from taxation on mobile tax bases to less mobile ones, which could be seen as one of the results of rising tax competition. We assume that a decrease in corporate tax revenues is compensated for by higher tax revenues from taxing work and property. Our dataset consists of panel date from 22 OECD countries within the period 1965 to 2012. We tested the potential causalities within the tax mix using Granger causality tests as well as the DOLS and FMOLS panel cointegration techniques in order to reveal possible long run causalities. As far as we know, these techniques have not before been used in this field. Long-run inverse causalities between corporate tax and personal tax revenue as well as corporate tax revenue and indirect taxes are found. Our results could have several important implications for the tax policies in developed countries.

Keywords: tax revenue, tax competition, panel cointegration, DOLS, FMOLS, tax policy, tax mix

INTRODUCTION

The processes of globalization and economic integration enabled the rising mobility of capital and work. The mobility of work is still limited by several restrictions, but capital can be moved very quickly across the borders. Moreover, global mobility has been enhanced with the gradual increase in the importance of multinationals. Capital moves globally without any significant barriers, but the national tax systems are limited only to certain tax jurisdictions. This opens the door for a relatively simple shift of mobile tax bases from one country to another in order to perform tax optimization or tax avoidance. When the tax burden of capital becomes significantly higher in one country compared to other comparable countries, the outflow of the capital from this country can be expected in the near future. Thus, governments are to some extent forced not to raise the tax burden of capital. Furthermore, they may try to lower the corporate tax burden in order to attract investment into the jurisdiction. This situation is referred to as tax competition and can lead to decreases in tax revenue from the taxes on capital in most countries. The missing revenue can be either substituted for by the higher taxation of other less mobile sources, or the lower tax revenue will lead to a reduction in public expenditure or an increase in public debt. Our paper is focused on the consequences of tax competition for the level of tax revenue and its structure in OECD countries. We try to find some empirical support for the existence of a long-run shift from tax revenue from corporate taxes to tax revenue from personal income taxes, property taxes or indirect taxes.

Literature Review

Kubátová (2010) considers tax competition as attracting tax bases to tax jurisdictions by reducing the tax burden, either by lowering the tax rates or by narrowing the tax bases. She also emphasises that

tax competition is more important in the case of mobile tax bases such as corporate taxes.

The first comprehensive theoretical description and analysis of tax competition was done by Tiebout (1965). However, Tiebout's study is not focused on tax competition among countries but on tax competition among local governments. Assuming the total mobility of the tax base, Tiebout's analysis implies that the tax base will move to the jurisdiction where the ratio of the public services quantity or quality and the tax burden reaches an optimum. This process could force local governments to adopt measures to meet expectations of tax payers in the region. Široký (2013) distinguishes harmless and harmful tax competition. Harmless tax competition is some kind of fair tax competition, which reflects only the preferences of citizens. On the other hand harmful tax competition is non-cooperative tax cuts, which are aimed directly at attracting to the tax base. As stated by Talpos and Crasneac (2010) the tax competition literature does not offer a clear view on the implications of tax competition for the economy. On the one hand, tax competition leads to a reduction of taxes levied on mobile factors but on the other hand it increases the efficiency of public funds. Kubatová (2011) states that tax competition could lead to inappropriate restrictions and under-sizing of the state's functions. This potential effect of tax competition was mentioned by Oates (1972). He argued that tax competition leads to inefficiency in the public sector, when governments are trying to cut tax rates to attract tax bases regardless of declining tax revenues. This can lead to the so called "race to the bottom", when the tax rates and tax revenues of competing countries gradually decline to a very low or even zero level. The existence of corporate tax competition has been empirically supported for example by Slemrod (2004) or Devereux (2008). Huňady and Orviská (2014a) using panel cointegration and panel vector error correction models, find relatively strong empirical support for the existence of corporate tax competition between neighbouring EU countries. Moreover, our previous analysis using fixed-effect regression published in Huňady, Orviská (2014b) showed that a higher corporate tax rate in neighbouring countries generally implies a higher tax rate in the country itself. However, the level of corporate tax rate in the country is also determined by other factors such as the openness of the economy, public debt, GDP per capita, public expenditures and the level of corruption in the country.

Zodrow and Mieszowski (1986) analyzed the impact of tax competition on tax rates and tax revenues by one of the first complex tax-competition models. They also found that tax competition could lead to diminishing tax rates on capital income and this will probably cause less tax revenue and a suboptimal level of public goods. Wilson (1999) assumes that this long lasting effect of tax competition will lead to the unsustainably of the welfare state as an economic model. Devereux (2008) argues that increasing the level of competition between countries over mobile firms, capital and profits is consistent with a continuing fall in statutory and effective corporate tax rates in the OECD and EU. Sobotková and Solilová (2011) also state, that despite several positives, tax competition of mobile tax bases could cause a reduction in public revenues and the economic growth of the countries. On the other hand, for example, Donath and Slavin (2009) reported that the consequences of tax competition are more complex and do not necessarily lead to a race to the bottom. The geographical location or the concentration of production may lead to different optimal levels of taxation between regions.

Avi-Yonah (2000) argues that increasing pressure from tax competition causes the shift of tax burden form capital to labour, which is less mobile. This has several negative consequences for the equity of taxation. The author also emphasis the fact the decrease in the tax burden on capital is the consequence of growing openness of the economies. Plümper, Troeger and Winner (2009) argue that despite the fact that tax competition causes a shifting of the tax burden to less mobile factors, the fiscal rules and social equity norms put upward pressure on capital taxation, which returns the taxation of capital back close to its optimum. They also find that governments that are less restricted with some fiscal rules or equity norms have lower tax burdens. Winner (2005) finds out that the shift from the tax burden on capital to the tax burden on labour is especially evident in smaller countries. Nerudová and Kapounek (2007) argue that increases in the capital mobility forces EU member states to decrease the tax burden on capital and the lower tax revenue on capital taxation has to be compensated for by an increase in the tax burden on labour. However, based on their results of time series cointegration analysis they find a negative relation between capital mobility and the level of capital tax rate only in a minority of states used in the sample. Moreover, they found the negative relation between tax revenue from taxation of capital and tax revenue from taxation of labour only in 3 out of 22 countries included in the sample. Nerudová (2011) also argued that mobility of capital allows taxpayers to shift the tax base to countries with lower tax burdens. She also stated that tax competition may cause an increase in the tax burden on less mobile factors, and a decrease in the tax burden on factors, with the highest mobility.

Appel (2011) claims that while European policymakers have long acknowledged the shift of taxes away from highly mobile revenue sources to less mobile sources, academics are somewhat less unified in their interpretations of this problem. Szarowská (2013) also emphasises the fact, that higher mobility of capital has generated the perception that the tax burden on capital will be shifted to labour. The relative mobility of capital also stimulated apprehension about the race-to-

the bottom in the taxation of capital. However, the results of empirical analysis done by the author provides mixed evidence for this theoretical assumption. She finds that the taxes on capital have decreased by 2.1 p.p., the implicit tax on labour has decreased by 1.9 p.p. and taxes on consumption have increased by 0.4 p.p. between 1995 and 2010 in EU member states. Despite the significant drop in corporate tax revenue in the recent past, it is important to say that, when taking account of long-term data, the importance of corporate taxes does not diminish at all, as stated for example by Vítek (2011). There are various factors that may cause this situation. Besides the likely increase in the share of the corporate sector and profits, there could be a possible shift from personal income taxation to corporate taxation by changing the legal form as reported by Clausing (2006). The second is especially evident when the corporate tax rate is significantly lower than the tax rate on personal income. The shift from personal to corporate taxation has been empirically supported by the results of Kubátová and Říhová (2009). They argue that the difference between the marginal tax rate on personal income and corporate income is proved to be a statistically significant factor of corporate tax revenue in the OECD countries.

METHODOLOGY AND DATA

The main aim of the paper is to identify the potential long-run causality between the different type of tax revenues and corporate tax revenues in selected OECD countries. We decide to test three hypotheses listed below.

H01: There is an inverse long-run relationship between the corporate tax revenue and personal income tax.

H02: There is an inverse long-run relationship between the corporate tax revenue and taxes on goods and services.

H03: There is an inverse long-run relationship between the corporate tax revenue and taxes on property.

According to the nature of corporate taxation, we believe that the tax base of this tax is the most mobile of all taxes in a standard tax system. We assume that any decrease in corporate tax revenue is partly or fully compensated with the taxation of personal income, consumption and property, due to lower mobility of tax bases in the case of these taxes. This kind of shift in tax revenue structure is frequently reported in the literature on tax competition, as the potential consequence of tax competition as mentioned in the literature review.

Since we use panel data regressions, all variables include the cross-sectional dimension as well as time dimension. According to our focus on long-run causalities we decide to use the longest time dimension possible, despite the lower number of countries included in the sample (due to data unavailability). The panel data used in the models contains observations on selected variables for 22 OECD between 1965 and 2012. Due to eight missing observations, we get a slightly unbalanced panel with 1048 observations. These 22 countries have been included in the sample: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, Turkey, UK, and USA.

All variables used in the models are summarized in Tab. I. The inflation rate as well as GDP per capita have been used as control variables. The effect of inflation on tax revenue could be significant and we want to adjust the tax revenues for possible effects of inflation. We also want to control for the changes in GDP, which could affect all indicators used in the model. This can also help us to determine the effect of product changes and the economic cycle on different type of tax revenue.

In order to test the assumed causal links between the different types of tax revenues we conducted panel regression analysis. Due to non-stationary variables as well as the need to capture long-run dynamic relationship we decide to use panel cointegrated regression models. More specifically,

I: *The variables used in the models*

Dependent variable	Abbreviation	Data source
Corporate income tax revenue as % of GDP	CIT	OECD tax database (http://stats.oecd.org/)
Independent variables		
Personal income tax revenue as % of GDP	PIT	OECD tax database (http://stats.oecd.org/)
Tax revenue from taxation of goods and services as % of GDP	TGS	OECD tax database (http://stats.oecd.org/)
Tax revenue from property taxes as % of GDP	PT	OECD tax database (http://stats.oecd.org/)
Inflation rate (GDP deflator)	INFL	World bank database (http://databank.worldbank.org)
GDP per capita (PPP)	GDP_PC	World bank database (http://databank.worldbank.or)

Source: Authors

II: *The results of panel unit-root tests*

	LLC test	Breitung	IPS test	ADF test	PP test
CIT_GDP (intercept)	–1.4*		–1.2	61.9**	58.4*
1st diff. CIT_GDP (intercept)	–24.7***		–24.1***	538.5***	721.4***
PIT_GDP (intercept & trend)	–3.6***	–0.3	–1.7**	56.0	40.07
1st diff. PIT_GDP (intercept & trend)	–21.8***	–13.5***	–21.8***	435.8***	841.4***
PT_GDP (intercept)	–3.8***		–3.2***	83.6***	76.5***
PT_GDP (intercept & trend)	–1.2	1.4	–2.1**	77.5***	82.8***
1st diff PT_GDP (intercept & trend)	–19.3***	–11.3***	–20.8***	429.7***	1506.5***
TGS_GDP (intercept)	0.19		0.21	53.4	62.2**
1st diff. TGS_GDP (intercept)	–21.4***		–23.5***	520.6***	626.9***
GDP_PerCapita (intercept & trend)	–2.6	6.4	–0.73	90.6***	28.2
1st diff. GDP_PerCapita (intercept & trend)	–4.38***	–3.0	–10.7***	214.5***	350.3***
INFL (intercept)	–1.29*		–1.34*	53.967	96.1***
1st diff. INFL (intercept)	–17.24***		–20.89***	459.56***	688.21***

Source: Authors
Note: */**/*** means significance at the 10%/5%/1% levels of significance.

the DOLS and FMOLS panel cointegrated regression have been used. Based on this chosen methodology we are able to use non-stationary dynamic panels without facing potential problems of spurious regression or endogeneity problems, which is desirable in our case.

First of all we conducted the variety of panel-data unit root tests on level and first differences of variables used in the modes. Panel unit root tests are similar to unit root tests carried out on a single time series. However, the power of these tests is somewhat smaller than in the case of their time series counterparts. The results of all panel unit-root tests are summarized in Tab. II.

Subsequently, we have tested for the existence of cointegration between the dependent and independent variables using panel cointegration tests developed by Pedroni (1999, 2004) and Kao (1999). They are testing the null hypotheses of no cointegration between panel variables and both are widely used in the empirical literature. The Pedroni (1999, 2004) cointegration tests use seven different statistics. Four of them are panel cointegration statistics based on the within approach and three of them are group panel cointegration which are based on the between approach. Kao (1999) tests the null hypothesis that the residuals from the estimation are non-stationary. Furthermore, we also used the panel version of a relatively conventional Johansen cointegration test in order to verify the results. The panel cointegration tests allow us to identify the presence of cointegration but could not estimate any long-run coefficients. For this purpose we decide to use panel cointegrated regression models. The long run parameters are estimated by using the dynamic OLS (DOLS) and fully modified OLS (FMOLS) as panel cointegration estimators. The DOLS estimator is proposed by Saikkonen (1991) and Kao and Chiang (2000) and FMOLS estimator is developed by Phillips and Moon (1999) and Pedroni (2001).

Both FMOLS and DOLS are based on the standard OLS considering the simple fixed-effects panel regression model that can be written as

$$Y_{it} = \alpha_i + \beta_i X_{it} + u_{it},\ i = 1, \ldots, N,\ t = 1, \ldots, T, \quad (1)$$

where Y_{it} is a vector of dependent variable, β is a vector of slopes, α is individual fixed effect and u_{it} are stationary disturbance terms. It is assumed that X_{it} are integrated processes of order one for all *i*, where: $X_{it} = X_{it-1} + \varepsilon_{it}$, where the vector error process is $\xi_{it} = (\mu_{it}, \varepsilon_{it})'$.

The FMOLS estimator then can be written as follows:

$$\hat{\beta}_{FMOLS} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(x_{it} - \bar{x}_i)'\right]^{-1}\left[\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)\hat{y}_{it}^{+} + T\hat{\Delta}_{\varepsilon\mu}^{+}\right)\right], \quad (2)$$

where $\hat{\Delta}_{\varepsilon\mu}^{+}$ serial correlation term that gives covariance matrix of the residuals corrected for autocorrelation and $\hat{y}_{it}^{+}$ is the transformation of dependent variable y_{it} in order to achieve the endogeneity correction.

The DOLS estimator is obtained from the following equation:

$$y_{it} = \alpha_i + \beta X_{it} + \sum_{j=q_1}^{q_2} c_{ij}\Delta X_{i,t+j} + u_{it}, \quad (3)$$

where c_{ij} is the coefficient of leads and lags of first differenced independent variables.

The DOLS estimates of long-run coefficients β are super-consistent (Kao, Chiang, 2000).

Than we can estimate β long run coefficient by the following equation:

$$\hat{\beta}_{DOLS} = \sum_{i=1}^{N}\left[\sum_{t=1}^{T} z_{it} z_{it}'\right]^{-1}\left[\sum_{t=1}^{T} z_{it}\hat{y}_{it}^{+}\right], \quad (4)$$

where $z_{it} = (x_{it} - \bar{x}_i, \Delta x_{it-q}, \ldots, \Delta x_{it+q})$ is $2(q + 1) \times 1$ vector of regressors.

As stated, both estimators solve the potential problems with serial-correlation and endogeneity, which are the potential shortcomings of all common OLS estimators. The FMOLS estimator solves these problems by nonparametric corrections, while the DOLS estimator adds leads and lags of differenced repressors into the regression as parametric corrections.

RESULTS AND DISCUSSION

The basic descriptive statistics for tax revenue variables used in all regression models are shown in Tab. III. As it can be seen the taxes on goods and services followed by personal income taxes are on average the most important sources of tax revenue. On the other hand, the shares of property taxes and corporate taxes on GDP are significantly smaller in average of selected OECD countries.

As the first step of our analysis we test potential two-way causal relationship between different types of tax revenues using panel Granger causality test. As we can see from the results in the Tab. IV, corporate income tax revenue seems to Granger cause the personal income tax revenue at the 5% level of significance. The opposite direction is valid only at the 10% level of significance and there is no evident Granger causality between any other kind of tax revenues and corporate tax revenue. Thus there seems to be some significant causality in the Granger sense arising from corporate tax to personal income tax.

Subsequently, we perform the panel unit-root tests and panel cointegration tests in order to verify cointegration between selected variables. The results of the unit root test, summarized in the Appendix, suggest that all variables used in the model are non-stationary at levels but stationary at first differences, thus they seem to be I(1).

Next, we test the cointegration between the corporate tax revenue and other type of tax revenues using the Pedroni and Kao cointegration tests. Corporate tax revenue has been applied as the dependent variable in all three tests. The vast majority of the tests indicate the existence of a cointegration relationship between each pair of tax revenues (see Tab. V).

Furthermore, the control variables GDP per capita and inflation have been add to the cointegration test. The results of the Kao test after this change still indicate strong support for cointegration between personal income tax and corporate tax (see Tab. VI).

Furthermore, the panel Johansen Fisher cointegration test has been also applied in order to verify the existence of cointegration between selected variables. The results of these tests can be seen in Tab. VII.

After the unit root and cointegration tests, we proceeded to use the panel cointegrated regression in order to test the long-run causalities among the different types of tax revenue. The corporate tax revenue has been used as the main independent variable in all three models. The GDP per capita and inflation have been used as control variables. The results of the cointegrating regression using the models with intercept are summarized in Tab. VIII. As we can see, there is evident long-run causality arising from corporate income tax to personal income tax revenue.

The effect is negative and it is statistically significant at 1% level of significance in both cointegrating regression models. Thus, we can say that any potential decrease in the corporate income tax revenue is in the long-run partly substituted

III: *Descriptive statistics for the tax revenue variables*

	Corporate tax/GDP	Personal income tax/GDP	Taxes on goods and services/GDP	Property taxes/GDP
Mean	2.73	9.99	10.07	1.97
Median	2.40	9.60	10.7	1.8
Min./Max.	0.3/12.8	1.2/26.3	3.0/17.2	0.3/7.8
Std. Dev.	1.57	4.76	3.2	0.99
Obs.	1056	1053	1054	1054

Source: Authors

IV: *Pairwise Granger Causality Tests*

	F-statistics (4 lags)
ΔPersonal income tax (% GDP) does not Granger Cause ΔCorporate income tax (% GDP)	2.064*
ΔCorporate income tax (% GDP) does not Granger Cause ΔPersonal income tax (% GDP)	2.482**
ΔProperty taxes (% GDP) does not Granger Cause ΔCorporate income tax (% GDP)	1.783
ΔCorporate income tax (% GDP) does not Granger Cause ΔProperty taxes (% GDP)	0.196
ΔTaxes on goods and services (% GDP) does not Granger Cause Δ Corporate income tax (% GDP)	0.200
ΔCorporate income tax (% GDP) does not Granger Cause ΔTaxes on goods and services (% GDP)	1.825

Source: Authors
Note: Optimum lag lengths have been selected based on the Akaike information criterion, Final prediction error and sequential modified LR test statistics, */** means significance at the 10%/5% levels.

V: *The results of Pedroni and Kao cointegration tests*

Cointegration:		PIT, CIT		TGS, CIT		PT, CIT	
		Stat.	Weighted Stat.	Stat.	Weighted Stat.	Stat.	Weighted Stat.
Pedroni (Engle-Granger based) tests Automatic lag length selection based on AIC *H0: no cointegration*	Panel v-Statistic	0.66	0.20	–0.29	0.52	–1.13	–1.04
	Panel rho-Statistic	–2.98***	–2.75***	–0.86	–3.37***	–9.58***	–6.21***
	Panel PP-Statistic	–4.20***	–3.46***	–1.24	–4.05***	–9.04***	–6.44***
	Panel ADF-Statistic	–5.01***	–4.59***	–1.32*	–4.14***	–9.08***	–6.43***
	Group rho-Statistic	–0.68		–1.53*		–2.32**	
	Group PP-Statistic	–3.05***		–2.27**		–3.24***	
	Group ADF-Statistic	–4.17***		–2.6***		–3.47***	
Kao cointeg. Test *H0: no cointegration*	ADF-Statistic	–4.08***	–3.46***	–1.45*			

Source: Authors
Note: */**/*** means significance at the 10%/5%/1% levels.

VI: *The results of Kao cointegration test with added control variables*

		PIT, CIT, INFL, GDP_PC	TGS, CIT, INFL, GDP_PC	PT, CIT, INFL, GDP_PC
Kao cointeg. Test *H0: no cointegration*	ADF-Statistic	–3.65***	1.59*	1.33*

Source: Authors
Note: */**/*** means significance at the 10%/5%/1% levels.

VII: *The results of panel Johansen Fisher cointegration test*

Cointeg.	PIT, CIT, INLF, GDP_PC		TGS, CIT, INFL, GDP_PC		PT CIT, INFL, GDP_PC	
	Fisher stat. (from trace test)	Fisher stat. (from max-eigen test)	Fisher stat. (from trace test)	Fisher stat. (from max-eigen test)	Fisher stat. (from trace test)	Fisher stat. (from max-eigen test)
None	522.1***	411.6***	513.6***	492.8***	542.4***	354.7***
At most 1	215.4***	172.0***	223.7***	166.0***	254.5***	199.1***
At most 2	85.3***	67.25**	96.9***	50.5***	100.8***	82.8***
At most 3	**51.5**	**51.5**	**51.9**	**51.9**	**54.1**	**54.1**

Source: Authors
Note: */**/*** means significance at the 10%/5%/1% levels.

VIII: *The results of DOLS and FMOLS cointegrating regressions using the models with intercept*

Dependent variable:	PIT (% GDP)		TGS (% GDP)		PT (% GDP)	
	DOLS	FMOLS	DOLS	FMOLS	DOLS	FMOLS
Corporate income tax (% of GDP)	–0.30*** (–3.04)	–0.33*** (–3.4)	–0.15* (–1.86)	–0.139* (–1.89)	0.035 (1.29)	0.04 (1.52)
Inflation	0.02 (1.62)	0.02 (1.59)	–0.04*** (–4.33)	–0.04*** (–4.83)	–0.01*** (–3.33)	–0.01*** (–3.41)
Log (GDP per capita)	0.67*** (5.67)	0.77*** (6.66)	0.46*** (4.72)	0.40*** (4.56)	0.10*** (3.01)	0.09*** (2.78)
R2	0.91	0.89	0.88	0.85	0.80	0.76
Adj. R2	0.90	0.88	0.86	0.85	0.77	0.75
Long-run Variance	6.21	8.69	4.18	5.03	0.50	0.64

Source: Authors.
Note: */**/*** means significance at the 10%/5%/1% levels.

with an increase in personal income tax revenue. A similar effect is partially reflected also in the case of indirect taxes, but this is significant only at the 10% level of significance. However, there are some signs that the decrease in corporate tax

IX: *The results of DOLS and FMOLS cointegrated regressions – the models with intercept and trend*

Dependent variable:	Personal income tax (% GDP)		Taxes on goods and services (% GDP)		Property taxes (% GDP)	
Intercept & linear trend	**DOLS**	**FMOLS**	**DOLS**	**FMOLS**	**DOLS**	**FMOLS**
Corporate income tax (% of GDP)	–0.14 (–1.59)	–0.18** (–2.19)	–0.15** (–2.30)	–0.16*** (–2.79)	0.071** (2.46)	0.074*** (2.85)
Log (GDP per capita)	2.30*** (9.00)	2.43*** (9.70)	0.26 (1.41)	0.28*** (1.59)	–0.06 (–0.67)	–0.09*** (–1.14)
Inflation	0.02 (1.82)	0.01 (1.11)	–0.05*** (–8.79)	–0.05*** (–9.75)	–0.01*** (–4.10)	–0.01*** (–4.24)
R2	0.96	0.95	0.95	0.94	0.86	0.84
Adj. R2	0.96	0.95	0.94	0.93	0.85	0.84
Long-run Variance	2.41	3.45	1.43	1.76	0.28	0.34

Source: Authors
Note: */**/*** means significance at the 10%/5%/1% levels.

revenue can be also partially offset with the increase in indirect tax revenue.

The positive effect of GDP per capita is also evident. The effect is positive in all models used, thus the effect should not be due to the calculation of tax revenues as percentage of GDP. We can say that higher GDP has a positive long-run effect on personal income tax revenue as well as the revenues from taxes on goods and services and property taxes. However, the effect seems to be most intensive in the case of personal income tax. The negative effect of inflation appears to be significant for taxes on goods and services and property tax according to our results.

Based on the examination of tax revenues development over the time, we conclude that it could be also suitable to incorporate the linear trend in the equations. The results of regressions with linear trend and intercept are summarized in the Tab. IX. The long-run effect of corporate tax revenue on personal income tax revenue is significant only in the case of FMOLS regression. On the other hand, the long-run negative effect is even more significant for taxes on goods and services and property taxes. Nevertheless, the effect on property tax revenue is positive. This could be perhaps due to, the similar number of companies that pay the corporate as well as property taxes. This could also suggest a link between profits and land prices. The increased profits of firms could be reflected in the property market. However, these suggestions need more empirical support in possible further research.

We can say that decreasing revenue from corporate taxes could on one hand lead to the long-run increase in taxation of goods and services as well as personal taxes, but decrease in property tax revenue on the other hand.

As mentioned, several authors believe that tax competition could have different negative consequences for tax revenue level as well as their structure. There are theoretical models of tax competition, that present the possibility of the so called race to the bottom problem. This situation could lead to insufficient levels of tax revenue and under-provision of public goods. However, the intensity of tax competition and its consequences are highly dependent on the mobility of certain tax bases. In this respect, we believe that the corporate tax should be perhaps the most affected tax. A significant share of the literature devoted to tax competition, as Avi-Jonah (2000), Winner (2005), Nerudová (2011), claims that there could be some shift from taxation of capital to taxation of less mobile or immobile factors due to the pressure from tax competition. The results of our analysis support this view to a large extent. Based on the results, we cannot reject the null hypothesis 1 and 2. Thus, there is empirical evidence for the inverse long-run relationship between the corporate tax revenue and personal income tax as well as the corporate tax revenue and taxes on goods and services. On the other hand, we can reject the third hypothesis, because we are not able to find any significant inverse long-run relationship between corporate tax revenue and property tax revenue. Our findings suggest that there is substitution between the mentioned types of tax revenues in selected OECD countries in the long-run. To some extent similar research has been done by Nerudová and Kapounek (2007). They find out that the shift between taxes on capital and labour is evident only in a minority of EU countries. However, the methodology as well as the data used in our paper is different.

Alternatively, there could be several other potential approaches to this problem. Despite many advantages of our approach, it also entails several drawbacks. As the result of applying panel cointegration tests and panel cointegration regression we are not able to test the cointegration and causalities for individual countries in the sample but only for whole panel. This could be solved by using only time series data, but the sample size in each model would be significantly reduced this way. Furthermore, the tax revenue variables

used in our models could be also substituted with implicit tax rates, which would also mean clear differentiations of taxes impose on capital and those impose on labour. However, due to the fact that we want to make direct interpretation of our results in terms of taxes, which are actually used in tax systems (such as corporate income tax); we decide to apply selected approach.

CONCLUSION

According to our results, a potential 1 p.p. drop in share of corporate tax revenue on GDP may cause 0.18 to 0.33 p.p. increase in the share of personal tax revenue on GDP and approximately 0.16 p.p. increase in the share of indirect tax revenue on GDP in the long-run. It is likely that governments in the OECD are mostly used to replacing the missing revenue from corporate tax by the revenue from personal income taxes or indirect taxes, but not by tax revenue from property taxes. However, it is important to emphasize that a possible increase in corporate tax revenue is commonly accompanied by a decrease of tax revenue from mentioned taxes in the long-run. The shift between corporate tax and personal income tax revenue could be seen as the result of tax competition pressure or could also be interpreted as the consequence of changes in the legal form of economic subject as mentioned by Clausing (2006) and Kubatová and Říhová (2009). Certain entrepreneurs may at some circumstances change their legal status and decide whether their income will be subject to personal or corporate taxation. This could be an effective way to perform tax avoidance, when the difference between the corporate and personal tax burden is relatively high.

Our findings suggest that any potential drop in corporate tax revenue will be in the long-run partly substituted with by an increase in personal income tax and indirect taxes. However, this shift is only partial and more than the half of corporate tax revenue is still not substituted at all. Thus, in the case where corporate tax revenue falls the governments are probably not able to ensure the same total tax revenue, by the increase in tax burden on labour and property.

REFERENCES

APPEL, H. 2011. *Tax Politics in Eastern Europe: Globalization, Regional Integration and the Democratic Compromise*. Ann Arbor: University of Michigan Press.

AVI-YONAH, S. R. 2000. Globalization, Tax Competition And The Fiscal Crisis Of The Welfare State. *Harvard Law Review*, 113(7): 1573–1676. DOI 10.2139/ssrn.208748.

CLAUSING, K. A. 2007. Corporate Tax Revenues in OECD Countries. *International Tax and Public Finance*, 14(2): 115–133. DOI 10.1007/s10797-006-7983-2.

DEVEREUX, P. M. 2008. Business taxation in a globalized world. *Oxford Review of Economic Policy,* 24(4): 625–638.

DONATH, L. and SLAVIN, M. 2009. Tax competition and foreign direct investments. Is there a connection? *Analele Stiintifice ale Universitatii "Alexandru Ioan Cuza" din Iasi – Stiinte Economics*, 56(November): 117–132.

HUŇADY, J. and ORVISKÁ, M. 2014a. The empricial evidence for corporate tax competition among the EU member states. *Region Direct*, 7(1): 105–142. DOI 10.2478/regd-2014-0004.

HUŇADY, J. and ORVISKÁ, M. 2014b. Corporate tax competition and its potential implication for tax policies in EU countries. In: *19th International Conference on Theoretical and Practical Aspects of Public Finance*. Prague, April 2014. Prague: Wolters Kluwer, 126–136.

KAO, C. 1999. Spurious Regression and Residual Based Tests for Cointegration in Panel Data. *Journal of Econometrics,* 90(1): 1–44.

KAO, C. and CHIANG, M., H. 2000. On the Estimation and Inference of Cointegrated Regression in Panel Data. *Advances in Econometrics,* 15: 179–222.

KUBÁTOVÁ, K. 2010. *Daňová teórie a politika*. Prague: Wolters Kluwer.

KUBÁTOVÁ, K. and ŘÍHOVÁ, L. 2009. Regresní analýza faktorů ovlivňujících výnosy korporátní daně v zemích OECD. *Politická ekonomie*, 57(4): 451–470.

NERUDOVÁ, D. and KAPOUNEK, S. 2007. The Empirical Study of the Tax competition in the European union. *Acta Univ. Agric. Silvic. Mendelianae Brun.*, 55(3): 75–84. DOI 10.11118/actaun200755030075.

NERUDOVÁ, D. 2011. *Harmonizace daňových systémů zemí Evropské unie*. Prague: Wolters Kluwer.

OATES, W. 1972. *Fiscal Federalism*. New York: Harcourt Brace Jovanovich ed.

PEDRONI, P. 1999. Critical Values for Cointegration Test in Heterogeneous Panels with Multiple Regressors. *Oxford Bulletin of Economics and Statistics,* 61: 653–670.

PEDRONI, P. 2000. Fully Modified OLS for Heterogeneous Cointegrated Panels. *Advances in Econometrics*, 15: 93–132. DOI 10.1016/S0731-9053(00)15004-2.

PEDRONI, P. 2004. Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Econometric Theory,* 20(3): 597–625. DOI 10.1017/S0266466604203073.

PHILLIPS, P. C. B. and MOON, H. R. 2000. Nonstationary Panel Data Analysis: An Overview

of Some Recent Developments. *Econometric Reviews*, 19: 263–286. DOI 10.1080/07474930008800473.

PLÜMPER, T., TROEGER, V. E. and WINNER, H. 2009. Why is There No Race to the Bottom in Capital Taxation? *International Studies Quarterly,* 53(3): 761–786. DOI 10.1111/j.1468-2478.2009.00555.x.

SOBOTKOVÁ, V. and SOLILOVÁ, V. 2011. Komparace CFC pravidiel ve vybraných státech EU. In: *Teoretické a praktické aspekty veřejných financí*. Prague: VŠE, Nakladatelství Oeconomica.

SLEMROD, J. 2004. Are corporate tax rates, or countries converging? *Journal of Public Economic*, 88: 1160–1186. DOI 0.1016/S0047-2727(03)00061-6.

SZAROWSKÁ, I. 2013. Shift in tax burden and its impact on Economic Growth in the European Union. *Acta Univ. Agric. Silvic. Mendelianae Brun.*, 59(4): 1153–1160. DOI 10.11118/actaun201361041153.

ŠIROKÝ, J. 2013. *Daně v Evropské únii*. Prague: Linde.

TALPOS, I. and CRASNEAC, A. O. 2010. The Effects of Tax Competition. *Theoretical and Applied Economics*, 17(8): 39–52.

TIEBOUT, C. 1956. A pure theory of local government expenditures. *Journal of Political Economy*, 64: 416–424.

VÍTEK, L. 2011. Impact of the Economic Crisis on Corporate Taxation. In: VÍTEK, L. (ed.), *Analysis of the Impact of the Economic Crisis on Public Finance*. Prague: Wolter Kluwer, 221–243.

WILSON, J. D. 1999. Theories of Tax Competition. *National Tax Journal*, 52(Jun): 269–304.

WINNER, H. 2005. Has Tax Competition Emerged in OECD Countries? Evidence from panel data. *International Tax and Public Finance*, 12: 667–687. DOI 10.1007/s10797-005-2915-0.

ZODROW, G. R. and MIESZKOWSKI, P. 1986. Pigou, Tiebout, Property Taxation and the Underprovision of Local Public Goods. *Journal of Urban Economics*, 19(3): 356–370. DOI 10.1006/juec.1995.1035.

Contact information

Ján Huňady: jan.hunady@umb.sk
Marta Orviská: marta.orviska@umb.sk