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Co-moves of Sub-national and Central Government Tax Revenues in European Countries

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ABSTRACT

The aim of the paper is to elicit the nature of the co-moves of sub-national and central governments' tax revenues employing main types of shared taxes - the personal income tax and the corporate income tax. Estimating the instrumental variable panel model based on the two stage least square estimator, the relationship between the sub-national government tax revenues and central government receipts from income (shared) taxes is investigated on the sample of 28 countries (EU and UK) in the period of 1995-2019. Expectation about inverse relationship is based on countermove of central and sub-national governments' portions on shared taxes assuming that sub-national tax revenues are importantly affected by revenues from shared tax. However, results show, that observed negative effect of central government receipts from shared tax on sub-national tax revenues origins in overall decrease of receipts from income taxes in a notable part of the monitored period and in simultaneous increase of other sub-national tax revenues. Expecting cuts in income taxes due to the financial crisis, sub-national governments sought for other taxable resources and generated the additional tax revenue and increased their total tax revenues significantly. Additionally, the heterogeneous period covers beside the break caused by the financial crisis also certain breaks corresponding to structural reforms in post-communist countries. Both require centrally provided stabilization and redistribution and are resource demanding, what is against the shift of resources to lower government levels, what creates the same impetus for sub-national governments in aim to seek for other tax resources.

INTRODUCTION

Tax revenues of sub-national governments are important in the local, spatially constrained, perspective of public goods provisioning. Naturally, local own tax resources are not a sufficient source of local funding (Bergvall et al., 2006). Usually, taxes shared among central and sub-national governments and grants co-fund local public goods. It is obvious, that in many sub-national budgets, shared taxes receipts represent a very abundant source of finance (Blöchliger and Petzold, 2009a), while own tax resources

are related to limited fiscal capacity of localities. That is why persistent vertical fiscal imbalance, as well as horizontal fiscal imbalance, is softened by sharing mobile tax base. Income taxes belong among the most common shared taxes (Blöchliger and King, 2006; Blöchliger and Petzold, 2009a).

Supposing that sub-national budgets are influenced by shared tax revenues importantly, the motivation of the paper focuses in uncovering, how do the sub-national governments react on changes in the central governments' portion on shared taxes. The paper employs main types of shared taxes - the personal and corporate income tax of the central government level and sub-national government tax revenues. Using the two stage regression analysis, the impact of central government shared tax revenues on sub-national government tax revenue is examined. First, the antagonistic move of central and sub-national governments' portions on shared tax is expectable. Beside it, the eventual decrease of receipts from the shared taxes in sub-national budgets might motivate the sub-national governments to seek for other taxable resources to generate the additional revenue, to ameliorate their revenue position and to provide sufficient level and quality of public goods. It is well known, that sub-national governments have certain power to rise the immovable property tax rates with immobile tax base (in the accordance with the Theory of Fiscal Federalism propositions, see e.g. Musgrave, 1959 or Oates, 1999). But as mention Blöchliger and Petzold (2009a), it will increase the total tax burden, too. According to them, the tax effort of sub-national governments could be strengthened by tax sharing without increasing the total tax burden. However, the side effect of tax sharing might appear. If sub-national governments anticipate higher portions in shared taxes, they might lose their motivation to seek for other budget resources (the flypaper effect might appear, Allers and Vermuelen, 2016).

1. STATE OF THE ART

Sharing the revenues and competences among different government levels belongs to the basic principles of the decentralized fiscal systems. The idea of tax revenue sharing is permanently under scrutiny in myriad of theoretical and empirical studies for a long time, since the possibilities of decentralization of public finance functions were explained in the 1950's. In earlier works (Morss, 1967; Flowers, 1988) the attention was paid to the definition of basic relations and principles of tax sharing. Morss (1967, p. 424) understands the tax sharing as an arrangement "whereby part of the tax revenue collected by the federal government are made available to other governments, with no direct stipulation as to how they should be used". Gurusurthi (1998) mentions, that vertical tax revenue sharing is one of the most important issues of tax sharing and intergovernmental fiscal relations, too. Tax revenue sharing might deal with the vertical, as well as horizontal fiscal imbalances. However, differences in fiscal position of sub-national governments due to the unequally distributed tax base over the area are often equalized by intergovernmental grants (Blöchliger and Petzold, 2009a). In fact, similarities among shared taxes and unconditional grants are stressed systematically by many authors (e.g. Morss, 1967; Ebel and Yilmaz, 2002; Blöchliger and Petzold, 2009a, 2009b; Sharma, 2012). Forasmuch as there was a discussion about the nature and economic impact of shared taxes on local financial autonomy, the Organisation for economic Co-operation and Development (OECD) and Council of Europe provide "a European definition of shared taxes". According to this definition, in case of shared tax the central government retains the control over the tax rate and tax base and these nonexclusive fiscal resources are financial transfers (OECD, 2006).

According to Blöchliger and King (2006), personal income tax, corporate income tax and value added tax are the most common taxes involved to sharing arrangements. As it is obvious from their research, that also the value added tax is often employed as shared tax in many countries, Blöchliger and Petzold (2009a) discuss about its convenience. They cite the works of McLure (2005) or Martinez-Vazquez (2008) who propose a value added tax and sales taxes to be shared, but Blöchliger and Petzold (2009a) argues that this praxis is applied more likely in large regional jurisdictions. From this reason, when analysing the sub-national revenue mix, they analysed the income taxes, with more accent on corporate income tax. They mention portions of central and sub-national tax revenues from income and stress, that the income tax is the predominant tax at the sub-national level (in OECD countries).

The support of sharing the personal and corporate income taxes is given in the theory, too. According to the proposition of the Theory of Fiscal Federalism (Oates, 1972 and 1999), progressive income taxes (with mobile tax base) should be collected by the central government level. Thereafter they should be shared among governments. The reason, why the income tax should be not assigned to the local government resist in two main reasons. Its sensibility to business cycle and external shocks might affect its receipts. In addition, if assigned to local governments, potential undesired tax competition could be boosted by local governments. It might lead to migration of the mobile tax base resulting in increase of pressure on local budgets, deepening regional disparities or in race-to-the bottom (Razin and Sadka, 2011).

In fact, beside intergovernmental grants and transfers, shared taxes present a direct connection between central and sub-national governments. In the empirical evidence, the extent of revenue from own and shared taxes are investigated in many aspects, e.g. the vertical fiscal imbalance (Sharma, 2012; Eyrud and Lusinyan, 2013) the importance of own tax revenues due to sub-national responsibility over resources, tasks and spending (Bird, 2015), the revenue diversification (Jordan et al., 2017; Propheter, 2019). It is evident, that through tax sharing, moves in central government tax revenues induce certain changes in sub-national government tax revenues. Here the question arises, how do sub-national governments react on these changes.

2. METHODS AND DATA

The main research method is econometric regression based on instrumental panel data approach. Simultaneous equation model often named as two stage least square model (TSLS or 2SLS) for panel data is estimated to avoid the estimation bias evoked by the presence of endogenous explanatory variables or unobserved heterogeneity in the model described e.g. in Semykina and Wooldridge (2010). Endogenous right-hand-side covariates could be correlated with the error term, contrary to the simple panel model, where right-hand side variables are assumed to be strictly exogenous. Instruments included to the estimation are exogenous and uncorrelated with the error term, but correlated with endogenous variables. The discussion about the best fit provided at the base of the TSLS, also known as instrumental variables models (IV models), is led in plethora of studies (Baltagi and Li, 1992; Baltagi and Liu, 2009, Han, 2016).

TSLS models are usually tested against the OLS estimator using the Hausman test (Null hypothesis: OLS estimates are consistent). Sargan over-identification test serves to test the validity of instruments (Null hypothesis: all instruments are valid). In instrumental variable models, instruments bear the interest in a lot of studies (Stock and Yogo, 2005; Olea and Pflueger, 2013; Sanderson and Windmeijer, 2016). Many of them (e.g. Stock and Yogo, 2005; Sanderson and Windmeijer, 2016) describe a situation, when Wald test for underidentified instruments is insufficient in the case of multiple endogenous regressors in the equation and as a solution they promote the use of Cragg-Donald test (Cragg and Donald, 1993) with reference on Stock and Yogo (2005). In this test, the Cragg-Donald minimum eigenvalue is compared to threshold computed in Stock and Yogo (2005). Two types of tests / two types of critical values are on disposal in standard econometric software: critical values for TSLS bias relative to OLS and critical values for desired TSLS maximal size, when running tests at a nominal 5% significance level. If the Cragg-Donald minimum eigenvalue exceeds the relative bias or maximal size suggest by the test, the null hypothesis of weak instruments is rejected.

Data are collected for 28 European countries (actual EU members and UK) on the annual base from the Eurostat (2021) in the period 1995 – 2019. Dependent variable mirrors the tax revenue of lower government levels – local and state (abbreviated as LG and SG, beside it, CG stays for central government and GG for general government). Local government level exists in all countries in the question, state government level exists in federations as Belgium, Germany and Austria and in Spain with autonomous regions. Hence, the “sub-national” stays for “local and state” in federations and “local” in unitary states. According to this, the research distinguishes among local and sub-national government tax revenues. Local government tax revenues (LGTaxR) are expressed as total tax receipts of local government level. Sub-national government tax revenues (SubGTaxR) include total tax receipts of local and state gov-

ernment level as sub-national government levels (SubG). LGTaxR is examined separately to filter out the influence of federative constitution of mentioned countries.

Explanatory endogenous (instrumented) variables are central government tax revenues from main types of income taxes, which are recommended to be shared - the personal income tax (PIT) and corporate income tax (CIT). As instrumental variables, macroeconomic and demographic variables as growth of GDP per capita, inflation rate, public debt relative to GDP, openness of economy, unemployment rate, population growth or dependency ratio were considered. Their description in detail is given in Table 1. They refer predominantly on the business cycle phases and redistribution pressures on public budgets. As suggests ten Theory of Fiscal Federalism (Oates, 1999), the principle of central stabilization and central redistribution should be applied in a federal fiscal system. Thus, instrumental variables have impact on central government activities, while central government activities influence sub-national governments and their budgets.

Table 1. List of variables

<i>Variable</i>	<i>Label</i>	<i>Description</i>	<i>Source</i>
Dependent variables			
Sub-national government tax revenue	SubGTax	Total tax receipts of Sub-national government - sum of tax revenue of the State government (sector S1312) and the Local government (sector S1313) in % of GDP.	Eurostat (2021)
Local government tax revenue	LGTax	Total tax receipts of the Local government (sector S1313) in % of GDP.	Eurostat (2021)
Endogenous variables			
Central government Tax Receipt from Corporate Income Tax	CGCIT	Taxes on the income or profits of corporations as receipts of the Central government (sector S1311) in % of GDP.	Eurostat (2021)
Central government Tax Receipt from Personal Income Tax	CGPIT	Taxes on individual or household income as receipts of the Central government (sector S1311) in % of GDP.	Eurostat (2021)
Instruments			
Inflation rate	Infl	All-items HICP - annual average rate of change.	Eurostat (2021)
Growth of population*	gPop	Population.	Eurostat (2021)
Growth of GDP per capita*	gGDPpc	Gross domestic product at market prices (current prices, million Eur) per capita.	Eurostat (2021)
Growth of the dependency ratio*	gDepRat	Dependency ratio = share of unproductive (aged less than 15 and over 65 years) on productive (aged from 15 to 64 years) population.	Eurostat (2021)
Unemployment rate	Unempl	Unemployment rate from 15 to 74 years as % on active population.	Eurostat (2021)
Public debt	PubDebt	Government consolidated gross debt in % of GDP.	Eurostat (2021)
Openness	Open	Exports + Imports of goods and services in % of GDP.	Eurostat (2021)

Note: *Growth rate is calculated as $(Y_t - Y_{t-1}) / Y_{t-1}$

Source: own processing

3. RESULTS AND DISCUSSION

Computing the correlation coefficients among tax revenues of different government levels, the results unveiled that the central government total tax revenue (CGTaxR) is not correlated with LGTaxR and

SubGTaxR (see Tab. 2). Moderate correlation is observed in the case of CGPIT, CGCIT and LGTaxR or SubGTaxR (in the case of LGTaxR and CGCIT the correlation is weak, but adding the sub-national state level dimension to LGTaxR, the correlation coefficient increases. Beside it, CGPIT and CGCIT are positively correlated with CGTaxR, thus they create an important part of CGTaxR. From this reason are variables of CGPIT and CGCIT involved to the estimation as explanatory variables.

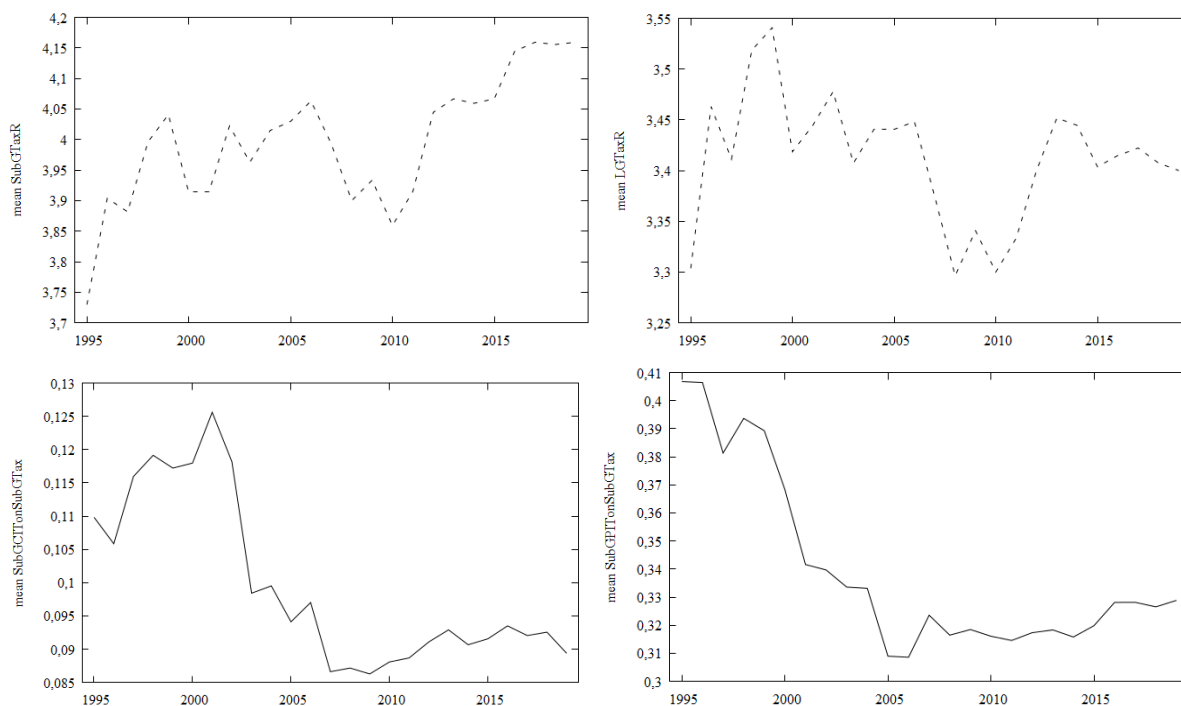
Table 2. Correlation coefficients of LGTaxR, SubGTaxR and CG tax items

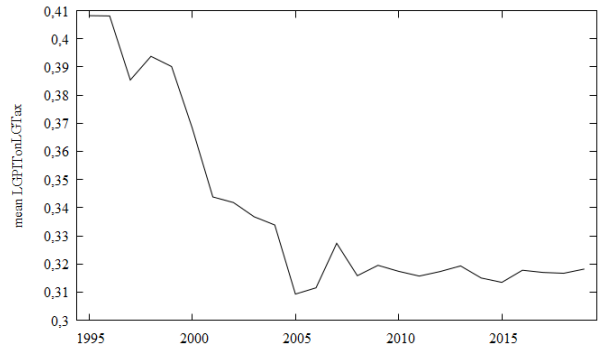
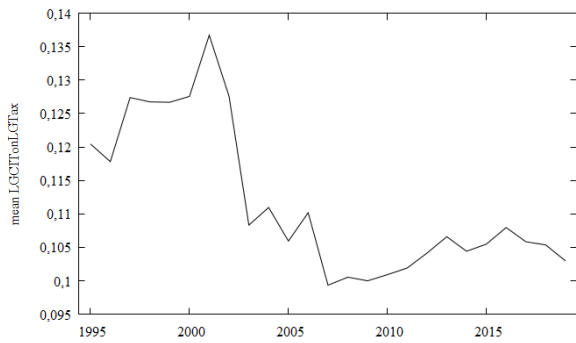
	LGTaxR	SubGTaxR	CGTaxR	CGVAT	CGEstTax	CGPIT	CGCIT
LGTaxR	1.0000	0.8283	0.1430	0.2294	0.2413	-0.3148	-0.1782
SubGTaxR		1.0000	-0.1182	-0.1092	0.1171	-0.2659	-0.3933
CGTaxR			1.0000	0.5226	0.4189	0.5809	0.4737
CGVAT				1.0000	0.1989	-0.0984	0.2270
CGEstTax					1.0000	0.0207	0.1195
CGPIT						1.0000	0.0842
CGCIT							1.0000

Source: own computation

Group means of SubGTaxR and LGTaxR and shares of CIT and PIT on SubGTaxR and LGTaxR in 1995-2019 are displayed in Fig. 1. It is evident, that SubGTaxR and LGTaxR increase in the monitored period, while the shares of CIT and PIT on SubGTaxR and LGTaxR decrease importantly since 2001. That signalizes the simultaneous increase of other source of tax revenue.

Figure 1. Group means of SubGTaxR, LGTaxR (%GDP) and shares of CIT and PIT on SubGTaxR and LGTaxR in 1995-2019



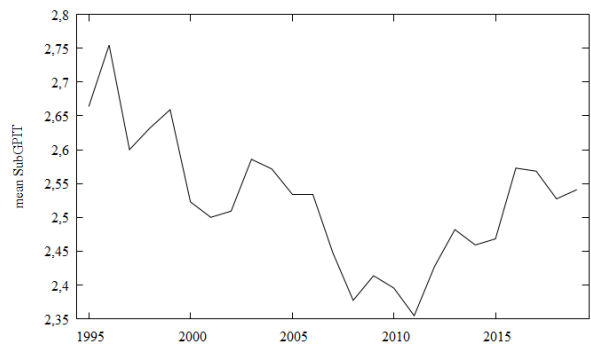
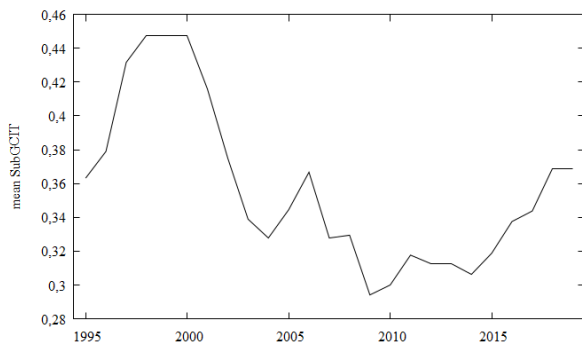
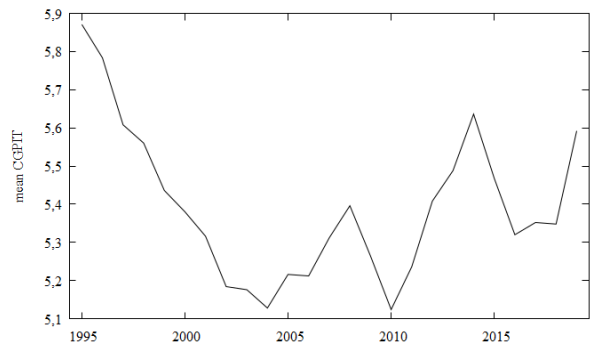
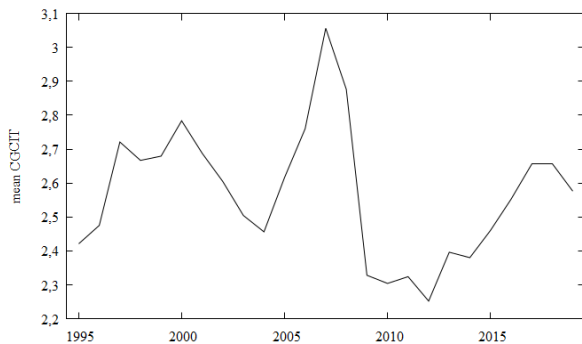


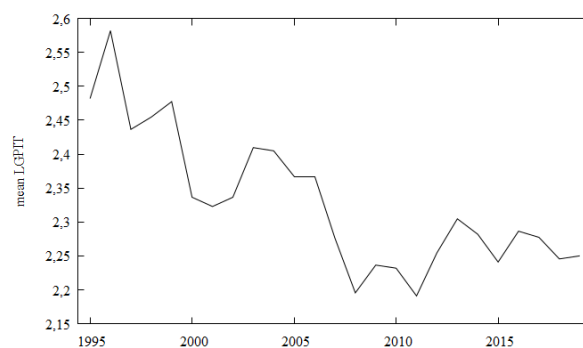
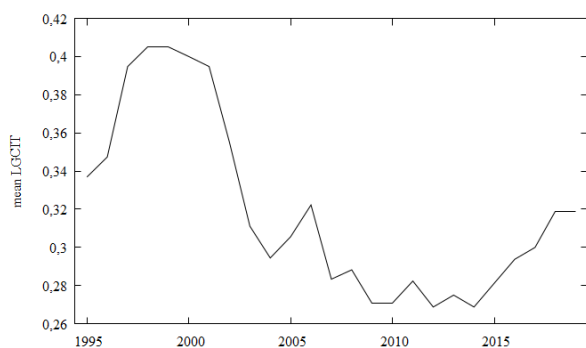
Source: own processing

To compare the evolution of the CIT and PIT within the public sector, group means of CIT and PIT of all government levels (CG, SubG and LG) in 1995-2019 are displayed in Fig. 2. The break in 2009 is evident in all monitored variables, what corresponds with massive financial crisis beating the economies all over the Europe (and world). The deepest decrease is observable in the case of CGCIT, while Blöchliger and Petzold (2009a) point to its unexpected increase in conditions of higher capital mobility inducing the tax competition before the financial crisis.

Although in the period of financial crisis the same tendencies in all variables are observed (see Fig. 1 and Fig. 2), the results projected in the Tab. 2 show, that moves of variables in question (CGPIT, CGCIT, SubTaxR, LGTaxR) are antagonistic (negative correlation) in the monitored period.

Figure 2. Group means of CGCIT, CGPIT, SubGCIT, SubGPIT, LGCIT and LGPIT in 1995-2019 (%GDP)





Source: ow processing

In the next step of the analysis, the regression analysis is provided. In Tab. 3 results of estimations are displayed. First, the estimations with the dependent variable of sub-national government tax revenues are projected using the TSLS. After it, the same procedure is repeated employing the local government tax revenues as dependent variable.

Table 3. Estimation results

Dependent variable	SubGTaxR		LGTaxR	
	estimate	significance	estimate	significance
constant	12.0610 (1.2397)	***	11.0563 (1.2300)	***
CGPIT	-0.0941 (0.1784)		-0.3216 (0.1770)	*
CGCIT	-2.9205 (0.5683)	***	-2.2532 (0.5638)	***
R2	0.0670		0.0708	
Hausman test	<0.0001		<0.0001	
Sargan test	0.2541		0.1624	
Cragg Donald Test (Weak instrument test)	minimum eigenvalue 14.1197		minimum eigenvalue 14.1197	
	Critical values for desired TSLS maximal size, when running tests at a nominal 5% significance level ^{A, B}		Critical values for desired TSLS maximal size, when running tests at a nominal 5% significance level ^{A, B}	
	size	10% 15% 20% 25%	size	10% 15% 20% 25%
	value	13.43 8.18 6.40 5.45	value	13.43 8.18 6.40 5.45
	Maximal size is probably less than 10% ^C		Maximal size is probably less than 10% ^C	
No. of obs.	540		540	
Instruments: PubDebt, Infl, Open				

Notes: *** denotes significance at the 1% level of significance, ** at 5% and * at 10% level of significance. Standard errors in parentheses.

^A Defined for n=2 and K=3 (n is number of endogenous regressors, K is number of instruments)

^B Test based on critical values for TSLS bias relative to OLS not applicable, critical values not defined for n=2 and K=3

^C Test refers on correspondent threshold, if size of 10% is proposed, correspondent value is 13.43 what is inferior to Cragg-Donald minimum eigenvalue 14.1197, null hypothesis of weak instruments is rejected.

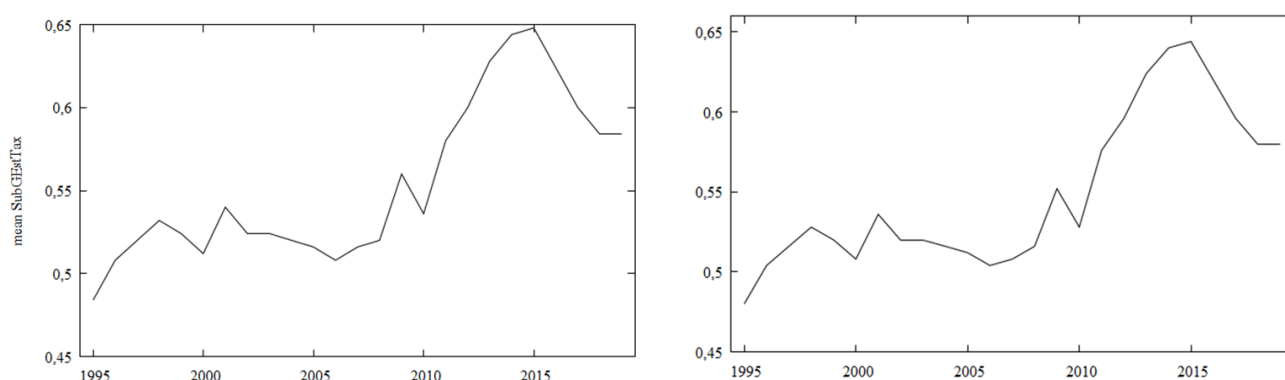
Source: own computation

According to the results of estimations, the relationship between central government receipts from CIT and PIT and tax revenues of sub-national (when considering the federative form of the state) and local governments is negative. Though, certain differences in estimated models are evident. In the case of the SubGTaxR, the estimate sign of the CGPIT variable is negative, but statistically insignificant, while in the LGTaxR model, which is in fact a reduced form of SubGTaxR, the CGPIT variable is statistically significant at 10% significance level with the same direction as it is in the case of SubGTaxR. In the case of both models, the Hausman test indicated the OLS is not consistent in favour of the TSLS estimation technique. Sargan test does not reject the null hypothesis, that all instruments are valid. Additionally, the weak instrument test rejects the null hypothesis of weak instruments.

Several observed facts contribute to the final results. First, it is obvious, that the central government level retains a higher part of the CIT and PIT receipts (see Fig. 2). Second, the dramatic decrease of central and sub-national government receipts from CIT and PIT in the period of the financial crisis was replaced by its gentle increase in next period, but it did not achieve the values that were observed before the financial crisis. Lower receipts from CIT and PIT in the sector bring lower amounts shifted to both central and sub-national budgets. Third, simultaneously, the share of CIT and PIT on sub-national and local tax revenues decreases in the monitored period (see Fig. 1).

Taking this into account, the estimated negative relationship between the central government portion on shared tax and sub-national governments tax revenues signalizes, that sub-national governments sought for other taxable resources and generated the additional revenue, what has increased their total tax revenues significantly. In fact, the correspondent increase of the sub-national revenue from real estate tax is registered since 2010 (see Fig. 3). In many EU countries, the real estate tax belongs to tax revenues with stable yield and it is very important budgetary and taxation tool at the sub-national level (Maličká, 2017).

Figure 3. Group means of SubG and LG Real Estate Tax Revenues (%GDP)



Source: ow processing

The impetus for seeking for additional tax resources and thus increasing the sub-national and/or local tax revenues might resist in several points. First, the fiscal decentralization as a part of public sector and tax reforms has influenced importantly the local economies. In the sample, there is a near half share of countries, which have overcome the process of the transition from the centrally-planned economies to the market-oriented ones. The process of the transition there had begun in 1990's, proceeded in early 2000's and has influenced both private and public sector (Abed and Davoodi, 2000; Verheijen, 2007). Public sector and public finance (and tax) reforms were realized including the fiscal decentralization. Under the fiscal decentralization, sub-national governments are beneficiaries of two types of tax revenues – revenues from shared taxes and own taxes. In the case of shared taxes, sub-national levels of government have not power to set tax rates (Blöchliger and King, 2006). Tax rates are set by parliament, which also decides about the shares yearly or the shares are given by law at the base of fix criteria. Con-

trary, sub- governments can operate in terms of own taxes. In this research, the heterogeneous period caused the overall decrease of tax receipts from CIT and PIT at all governments levels. Expecting certain cuts in CIT and PIT and in aim to compensate them, sub-national governments increased the revenue from the real estate tax rates more evidently in the period immediate to financial crisis, while the fiscal decentralization allowed them to manipulate the rates during the whole monitored period. It has caused the desired increase of sub-national tax revenues.

Second, the heterogeneity of the period could not be omitted. As it was mentioned hereinbefore, the monitored period covers the transition of post-communist economies. Beside it, the impact of the financial crisis in 2007-2008 cannot be neglected. Both this factors required the central government intervention to the economy. It is obvious, that to provide the government interventions, the creation of additional resources at the central government level is needed against the shift of resources to lower governments levels. In the case of the financial crisis, which influenced almost all countries in the sample, the realization of the redistribution and stabilization function of public finances was provided centrally (as promotes Musgrave, 1959; Oates 1972, 1999; Ebel and Yilmaz, 2002), because decentralized activities in the field of macroeconomic stabilization and redistribution covering the whole economy could result in overall destabilization of the economy. In the case of the transition process, government interventions in the field of infrastructure and basic reforms were necessary. Beside it, many of post-communistic countries suffered from economic depression in the beginning of their transition. Thus, regarding the monitored period, centrally provided interventions are counter the shift of additional tax resources to lower government levels (e.g. increase of shares on CIT or PIT), what is strengthened by the decrease of receipts from CIT and PIT in the economy. This contributed to the sub-national seeking for other tax resources, too.

CONCLUSION

In decentralized fiscal systems, where vertical fiscal imbalances are frequently present, certain co-moves of revenues of different level public budgets are expected and depend on the tax policy applied over the area. Shared taxes present an interface among different government levels' budgets. They influence sub-national budgets in an important way and determine the fiscal behaviour of sub-national governments. The increase of the revenue from shared tax in sub-national budgets can make the sub-national governments unmotivated to seek for own resources, while its decrease can bring them to situation, when they should get out of their comfort zone and raise own taxes. In fact, the fiscal behaviour of governments on all levels are influenced by concrete economic circumstances at the time. Intuitively, central government and sub-national governments should react on a variety of external and internal impulses.

The paper examines the co-move of the sub-national and/or local government tax revenue and central government receipts from income (shared) taxes employing the instrumental variable panel model based on the two stage least square estimator. Income taxes are in the focus, because they refer on the optimal design of the shared tax (proposed by the Theory of Fiscal Decentralization). On the sample of 28 European countries (EU and UK) in the period of 1995-2019 the negative relationship is observed. The portion of shared tax in sub-national tax revenues decreased, as well as decreased the total receipt of income taxes after the financial crisis. However, in the monitored period the increase of sub-national tax revenue is observed, when sub-national governments sought for other taxable resources and generated the additional tax revenue in line with the arrangements of the fiscal decentralization and in line with expecting cuts in income taxes due to crises and centrally provided government interventions.

The challenge of all fiscally decentralized schemes of public finances resists in the optimal degree of fiscal decentralization knowing that certain taxes are better suited for tax decentralization than others. Additionally, they have to be able to react on changing economic circumstances, as well as to exogenous factors. It is evident, that the ability of sub-national governments to deal with shocks in economy is limited, but the generosity of the central government can reduce their motivation in source seeking. The proper activity of sub-national government in the field of taxation is preferred to increase of its transfer dependency on the central government and this assertion will be under scrutiny as long as the taxes and fiscally decentralized systems will exist.

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