Torun Business Review

TAX EVASION ACROSS CENTRAL AND EASTERN EUROPE: EVIDENCE FROM A PANEL MODEL

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ABSTRACT

Mobilization of domestic revenue is of paramount importance in the context of the Central and Eastern Europe since most of these regional countries are dependent on multidimensional development assistance which are expected to exhibit a decreasing trend in future. However, the low ratio of tax revenue to GDP scenario across CEE is a major area of deep concern for the associated countries that have been ineffective in making remarkable improvements in their respective tax-GDP ratio. Thus, this paper aims to fill the gap in existing literature by modeling the tax evasion phenomenon across Estonia, Latvia, Lithuania, Czech Republic, Slovakia, Poland, Hungary, and Slovenia, Romania, Bulgaria and Croatia. The author employ annual data of relevant macroeconomic variables for the time period between 2004 and 2016. As part of the regression model, the authors express the tax-GDP ratio as a function of macroeconomic factors attributing to tax compliance in these countries. The collected data was analyzed using panel estimation techniques were also considered for robustness of the findings.

ARTICLE INFO

Available online 31 JULY 2018

Keywords:
taxes, tax evasion, panel econometrics

JEL: H26, F47, C54

Doi: 10.19197/tbr.v17i2.301

INTRODUCTION

Existing corporate taxation rules in the European Union (EU) do not keep pace with economic changes. Legal regulations regarding taxation of international enterprises' revenues do not match the market requirements. Recession and the financial crisis deepened the lack of public confidence in business and financial institutions and led to much greater public interest in tax evasion. The reasons for taxpayers to escape income tax are complex. One can see them both in the individual characteristics of the taxpayer and in the relations between him and the state. In the second case, the taxpayer's attitude is influenced by both the socio-economic policy pursued by the state and any other expression of the public authority's activity

That is why the European Commission adopted in June 2015 an action plan for fair and effective corporate taxation in the EU. This plan is intended to reform the tax framework of legal entities in the EU. Its goal is to combat tax fraud, ensure stable revenues and better conditions for doing business in the single market.

While the task of defining the concept of tax avoidance is not easy, one can assume that tax evasion refers to the act of paying less tax than you are legally obliged to pay as per the tax structure set by the state (Bishop, 2001). The lack of research on tax evasion by companies is incomprehensible, especially considering that in most countries most of taxes are paid by companies and companies also for the majority of tax evasion. (McCaffery and Slemrod, 2004; Crocker and Slemrod, 2005 ; Chang and Lai, 2004 , Nurtegin, 2008). As Slemrod (2007, p.36) points out, the literature on business tax evasion "adapts the theory of tax evasion, which for the most part concerns individual decision makers, to the tax compliance decisions made by businesses" .

This paper aims to fill the gap in existing literature by modeling the tax evasion and macroeconomic. The novelty of this study is its emphasis on macroeconomic indicators across Estonia, Latvia, Lithuania, Czech Republic, Slovakia, Poland, Hungary, Slovenia, Romania, Bulgaria and Croatia.

Conduct such a study by modeling the macroeconomic and socio-political variables that influence tax evasion. The novelty of this study is its dual emphasis on both macroeconomic indicators and socio-political indicators. The following questions are specifically addressed in this paper:

1. What are the macroeconomic factors that influencing tax evasion in the CEE?
2. What are the causal associations between tax avoidance and macroeconomic factors ?

In this paper, we focus on macroeconomic factors (GDP per capita, government expenditure, inflation, trade openness) and institutions (Institutional capacity and corruption). In our study, employ annual data of relevant macroeconomic variables for the time period between 2004 and 2016. As part of the regression model, the authors express the Tax-GDP ratio as a function of macroeconomic factors attributing to tax compliance in these countries. To analyze the data from 11 economies we employ a conventional fixed effects approach.

Data Specification

Dependent variable is tax evansion (tax revenue ratio to GDP): because a sufficient amount of public revenues is important for public spending and economic growth, the ratio of tax revenues to GDP has been used to measure and evaluate the success of fiscal management in a given country. Economic instability has also been identified as one of the main reasons for the low tax-to-GDP ratio in developing countries. In many empirical studies, domestic inflation was defined as a substitute variable for economic instability. A general understanding of this proxy selection lies in the fact that the inflation rate increases with the decline in economic stability. Other variables together with the source of their origin are presented in the table 1.

Table 1. Summary of independent variables

Variable	Description/Unit	Source
Tax- GDP	It refers to government's revenue collected from taxation tools and measured as a percentage of GDP.	World Development Indicators, 2017
GDPPC	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated	World Development Indicators, 2017

	without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars.	
GOV	General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security but excludes government military expenditures that are part of government capital formation.	World Development Indicators, 2017
INF	Inflation, as measured by the annual growth rate (in percentage terms) of the GDP implicit deflator, shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency.	World Development Indicators, 2017
IS	Institutional capacity =1/3(government effectiveness+ rule of law+ regulatory quality) = higher value represent strong institutional capacity Government Effectiveness 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. Rule of Law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contracten forcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Regulatory Quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	Own calculation, Worldwide Governance Indicators
OPN	We used the economic outcome measure of trade openness, which is export plus imports divided by GDP, all measured at current prices in USD.	World Development Indicators, 2017
COR	Control of Corruption index is used as a proxy for corruption. It reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as	Worldwide Governance Indicators, 2017

	"capture" of the state by elites and private interests. Higher values of the control of corruption index reflect better governance. Measured in the index value.	

Source: own development.

Econometric methodology

The empirical analysis was carried out on the basis of unitary balanced panel data from the World Bank, World Development Indicators database for the period 2004-2016. The data set includes annual tax evansion, GDP per capita, general government consumption, Institutional capacity, Inflation, trade openness and corruption in the countries of Central and Eastern Europe: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia. In this study, first, the amount of tax evasion is calculated for CEE countries. Next, the effect of macroeconomics variables on tax evasion is estimated and also we check a panel causality test developed by Dumitrescu-Hurlin (2012).

We use panel data because provides a large number of point data, increasing degrees of freedom and reducing collinearity between registries. Therefore, it allows for more efficient statistical tests. It can also take into account the heterogeneity of each cross-sectional unit and provides "greater variability, less collinearity between variables, more degrees of freedom and greater efficiency".

To investigate the determinants of tax evasion in transition economies, we estimate the following model:

$$\frac{Tax}{GDP} = \beta_0 + \beta_1 GDPPC_{it} + \beta_2 GOV_{it} + \beta_3 INF_{it} + \beta_4 IS_{it} + \beta_5 OPN_{it} + \beta_6 COR_{it} + \epsilon_{it} \dots (i)$$

where i denotes country (or cross-section) and t refers to time. In addition, $\frac{Tax}{GDP}$ is the tax-gdp ratio which was taken as a proxy for tax evasion; GDPPC is per capita GDP; GOV refers to government's expenditure; INF is inflation; IS is Institutional capacity; OPN is trade openness and COR is corruption. Table 2. displays the descriptive statistics for all variables; these data define the extent of our panel dataset. To our knowledge, this is the largest sample of transition countries so far used to assess the macroeconomics determinants on tax evasions.

Table 2. Descriptive statistics for the whole sample

	Tax- GDP	GDPPC	GOV	INF	IS	OPN	COR
Min.	1,23	3364	13,65	-9,68	50,6	0,57	46,8
1st	14,68	10122	17,5	1,07	66,98	0,915	60,35
Median	17,85	13640	18,6	2,44	75,13	1,2	66,7
Mean	15,73	13639	18,55	3,368	73,24	1,205	66,36
3rd	19,89	16594	19,87	4,75	79,73	1,45	71,95
Max.	23,88	27502	22,09	20,12	87,57	1,93	88

Source: own development using the R.

The first step for the investigation of panel data is to determine whether the series has any integration orders. For this purpose, this study employs panel unit root tests to check the stationarity of the panel data developed by Levin, Lin, and Chu (2002, hereafter LLC) and Im, Pesaran, and Shin (2003, here-after IPS), test CADF (Covariate Augmented Dickey-Fuller) .

The LLC (2002) unit root test considers the following panel ADF specification:

$$\Delta y_{i,t} = \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \delta_{i,j} \Delta y_{i,t-j} + \varepsilon_{i,t}$$

The LLC (2002) assumes that the persistence parameters ρ_i are identical across cross-sections (i.e., ρ_i=ρ r for all i), whereas the lag order ρ_i may freely vary. This procedure tests the null hypothesis ρ_i = 0 for all i against the alternative hypothesis ρ_i < 0 for all i. Rejection of the null hypothesis indicates a possible panel integration process .

The IPS (2003) proposed a testing procedure based on the mean group approach. The starting point of the IPS test is also the ADF . But, the null and alternative hypotheses are different from that of the LLC test, where the rejection of the null hypothesis implies that all the series are stationary. We now have:

$$H0: \beta_1 = \beta_2 = \beta_N = 0\ vs.\ H1: some\ but\ not\ necessarily\ all\ \beta_i \prec 0.$$

IPS developed two test statistics and called them the LM-bar and the t-bar tests. The t-bar statistics is calculated using the average t-statistics for β_i from the separate ADF regressions in the following fashion:

$$\bar{t}_{nT} = \frac{\sum_{i=1}^{n} t_{iT_i}(\beta_i)}{n}$$

where $t_{iT_i}(\beta_i)$ is the calculated ADF test statistic for individual i of the panel (i = 1, 2,…,n). The second step is to calculate the standardized t-bar statistic which is given by:

$$Z_{\bar{t}_{nT}} = \frac{\sqrt{n}\left[\bar{t}_{nT} - \frac{1}{n}\sum_{i=1}^{n} E\left(\bar{t}_{iT}(\beta_i)\right)\right]}{\sqrt{\frac{1}{n}\sum_{i=1}^{n} var\left(\bar{t}_{iT}(\beta_i)\right)}} \sim N(0,1)$$

where n is the size of the panel, which indicates the no. of individual, $E\left(\bar{t}_{iT}(\beta_i)\right)$ and $var\left(\bar{t}_{iT}(\beta_i)\right)$ a are provided by IPS for various values of T and p. However, Im, et al. (2003) suggested that in the presence of cross-sectional dependence, the data can be adjusted by demeaning and that the standardized demeaned t-bar statistic converges to the standard normal in the limit .

After analyzing cross-section dependency, we test the existence unit root in the series in order to get unbiased estimations. Several different panel unit root tests in accordance with the assumption of the cross-section dependence in the literature. In this study we take into account the averaged individual Cross-Sectionally Augmented Dickey Fuller (CADF). Pesaran (2003) proposes a test based on standard unit root statistics in a CADF regression. In general, the regression takes the form:

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{i,t-1} + \sum_{j=1}^{pi} \delta_{ij} \Delta Y_{i,t-1} + d_i \tau + c_i \bar{Y}_{t-1} + \sum_{j=0}^{pi} \varphi_{ij} \Delta \bar{Y}_{i,t-j} + \varepsilon_{it}$$

where, $\bar{Y}_t = N^{-1}\sum_{j=1}^{N} Y_{jt}$, $\Delta\bar{Y}_t = N^{-1}\sum_{j=1}^{N} \Delta Y_{jt}$ and ε_{it} is the serially uncorrelated regression error. Let CADFi be the ADF statistics for the i-th cross-sectional unit given by the t-ratio of the OLS estimate $\hat{\beta}_i$ of β_i the CADF regression.

One of the basic problems of panel data econometrics is cross-sectional dependence. It can be caused by high degrees of Tax-GDP or cross-unit relations may give rise to the existence of this problem. If the dependencies on the cross-sections appear in the panel data are the results generally become inconsistent and upward-biased (Bai & Kao, 2006) . In this case, we intend to perform on test the existence of cross-sectional dependence before the analysis. Pesaran proposed a cross-sectional dependency (CD) test under the null hypothesis of no cross-sectional dependence, which is asymptotically distributed as standard normal and efficient even in panels with small sample sizes. The Pesaran's CD test statistic in the present study is as follows:

$$CD = \frac{2T}{\sqrt{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{p}_{ij}\right)$$

where T is the time interval, N is the number of cross-section units, and $\hat{p}_{ij}$ is the pair-wise correlation between cross-sections.

Therefore, in order to determine the model specification, the fixed effects model should outperform the pooled OLS by using F-test and Pagan Lagrange multiplier (LM) test to determine the random effect model outperforming the pooled OLS. The appropriate applicability of a fixed effects estimation method over a random effects estimation method can be confirmed by the results from the Hausman (1978) test . The null hypothesis used in the test asserts that the random effects model is appropriate, which is tested against the alternative hypothesis asserting the fixed effects model to be more appropriate. Under this test, if the estimated value of the Chi-squares statistic is greater than the associated critical value then the null hypothesis can be rejected validating the acceptability of the fixed effects estimation method, vice-versa. For diagnostic purposes by applying test Breuscha Godfreya for autocorrelation and test Breuscha Pagana for heteroscedasticity .

Next in this study, a panel causality test developed by Dumitrescu-Hurlin (2012) was used . The main benefit of this method is that it is appropriate for panel data. The main prerequisite of this method is that variables, which will be used in the analysis, should be stationary (Dumitrescu and Hurlin, 2012). The linear panel regression model followed by Dumitrescu and Hurlin (2012) is as follows:

$$Y_{i,t} = a_i + \sum_{k=1}^{K} Y_i^k Y_{i,t-k} + \sum_{k=1}^{K} B_i^k X_{i,t-k} + \varepsilon_{i,t}$$

where Y is Tax-GDP and x is the vector of the macroeconomics variable (i.e., GDPPC, GOV, INF, IS, OPN and COR). In addition to this situation, "i" represents the number of panel. Moreover, "K" demonstrates optimum lag interval and "ε" shows the error term. Dumitrescu and Hurlin (2012) [1] state that "a homogeneous specification of the relation between the variables x and y does not allow to interpret causality relations if any individual from the sample has an economic behaviour different from that of the others". Thus, they propose an average Wald statistic that tests the null of no causal relationship for any of the cross-section units, $\mathrm{H0}: \beta_i = 0, (i = 1, \ldots, N)$; against the alternative hypothesis that causal relationships occur for at least one subgroup of the panel, $\mathrm{H0}: \beta_i = 0, (i = 1, \ldots, N_1); \beta_i \neq 0, (i = N_1 + 1), N_2 + 2, \ldots, N)$. Rejection of the null hypothesis with N_1=0 indicates that x Granger causes y for all i, whereas rejection of the null hypothesis with $N_1 > 0$ provides evidence that the regression model and the causal relations vary from one individual or the sample to another. Under these circumstances, the average of the individual Wald statistic generated by Dumitrescu and Hurlin (2012) assumes the following:

[1] It is a test statistic for heterogeneous panels based on the individual Wald statistics of Granger non causality averaged across the cross-section units.

$$W_{N,T}^{Hnc} = \frac{1}{n}\sum_{i=1}^{N} W_{i,T}$$

where $W_{i,T}$ is the individual Wald statistic for the i-th cross-section unit .

Results

For panel data analysis it is essential to check for cross-sectional dependence. The first step for the investigation of causality is to determine whether the series has any integration orders. For this purpose, this study employs panel unit root tests developed by Levin, Lin, and Chu (2002, hereafter LLC) and Im, Pesaran, and Shin (2003, hereafter IPS).

Table 1. Results of panel unit root tests (LLC and IPS)

Variable	IPS		LLC	
	With constant and trend (level)	With constant (1st difference)	With constant and trend (level)	With constant (1st difference)
Tax-GDP	-0.85547 (0.1961)	-2.5601 (0.005233)	-3.466 (0.0002641)	-4.8927 (4.972e-07)
GDPPC	-0.65472 (0.2563)	-4.4294 (4.724e-06)	-4.7414 (1.061e-06)	-5.8906 (1.924e-09)
GOV	-3.4883 (0.0002431)	-2.7462 (0.003014)	-6.5381 (3.116e-11)	-4.5699 (2.44e-06)
INF	-6.1197 (4.687e-10)	-2.5972 (0.004699)	-9.1199 (2.2e-16)	-4.9489 (3.733e-07)
IS	-3.5134 (0.0002212)	0.91267 (0.001807)	-4.9955 (2.934e-07)	-3.2395 (0.0005987)
OPN	-2.366 (0.00899)	1.7502 (0.0096)	-4.8364 (6.61e-07)	-2.0467 (0.02034)
COR	-1.9254 (0.02709)	-1.1944 (0.0116)	-4.5155 (3.159e-06)	-3.1338 (0.0008629)

Note: numbers in parentheses are p-values
Source: own development using the R.

The LLC and IPS tests were executed on data both in levels and first differences, and results were reported in Table 3. Tests show that all of the variables are stationary in first-difference. Also, we use CADF test the stationarity of individual invariant time series. CADF test was performed for all variables in order to take into account cross-sectional dependencies. The all of the variables are stationary in first-difference (table 4.).

Table 2. Results of panel unit root tests (CADF tests)

Variable	CADF	
	With constant and trend (level)	With constant (1st difference)
Tax- GDP	2,57E-01	2,57E-01
GDPPC	7,40E-02	7,40E-02
GOV	1,03E-02	1,03E-02
INF	6,08E-07	6,08E-07
IS	3,24E-01	3,24E-01
OPN	6,69E-02	6,69E-02

COR	1,90E-01	1,90E-01

Note: numbers are p-values
Source: own development using the R.

We test the existence of cross-sectional dependence before the analysis. According to test results given in Table 6, the null hypothesis is not rejected for the panel even at the 5% level of significance, indicating that there is no strong dependence on the cross-section.

Table 3. Cross-sectional dependence test results

	Statistic - CD	P-value
Pesaran's test	2.2819	0.2249

Source: own development using the R.

The study began with the Hausman test, which indicated the correlation between random errors and explanatory variables. The estimator of the panel model with random effects (RE) becomes loaded and inconsistent, which makes it preferable to estimate the parameters of the panel model with fixed effects (FE). Therefore, three specifications of the panel model with fixed effects were considered: a panel model with individual effects, a panel model with periodic effects, a panel model with individual and periodic effects jointly. For the next specifications, the F test was carried out, which indicated only the significance of individual effects. In the end, a panel model (FE) estimation with individual effects was made.

Table 4. Panel Fixed Effects Estimation of Model

Independent Variables	Dependent Variable: (Tax- GDP)	
	Coefficient	Standard Error
GDPPC	-0,00012 (0.005306)**	4.3974e-05
GOV	-0,05174 (0.528283)	8.1822e-02
INF	0,07782 (0.003024)**	2.5734e-02
IS	-0,05105 (0.264108)	4.5507e-02
OPN	2,55160 (0.000207) ***	6.6762e-01
COR	0,03524 (0.252429)	3.0647e-02
R2	0.20858	
Adjusted R2	0.10808	
Serial Autocorrelation: test Breuscha Godfreya	p-value = 0,08063	
Heterosedaskitcty test: Breusch-Pagan test	p-value = 2.2e-16	
Hausman Test	3.022e-05	

Source: own development using the R.

The relationship between GDPPC and tax evasion is negative across estimation but the coefficient is very small: a huge amount of extra income per capita is required to make any substantial difference in the level of tax evasion. Positive and significant association between inflation and tax evasion2, implies that one percent increase in inflation rate lead to the decrease in the tax evasion holdings by 0.08 percent. On the other hand, the positive relationship between OPN and tax evasion are the most economically influential and consistently statistically significant variables. It may be explained the case of a

[2] Similar results: Fishburn(p. 325-332, 1981).

large freedom of capital flows and harmonization of interest taxation and dividends paid out between entities within the European Union, and favors lower taxation of capital.
The estimates consistently suggest that GOV, IS and COR do not appear as statistically significant.

Knowing the causal direction between macroeconomic imbalances is obviously useful for decision-making in economic policy. We therefore perform use Dumitrescu and Hurlin (2012)[3] test for the causality from variables (GDPPC, GOV, INF, IS, OPN and COR), which correspond to the tests reported in Table X. The idea to determine the existence of causality is to test for significant effect of past values of x on the present value of y which implements a procedure recently, in order to test for Granger causality in panel datasets. The empirical results presented in this paper are based on a bivariate causality test between the five variables stated earlier. There are four sets of bidirectional hypotheses to be tested:

1. GDPPC Granger causes Tax- GDP and vice versa;
2. GOV Granger causes Tax- GDP and vice versa;
3. INF Granger causes Tax- GDP and vice versa;
4. IS Granger causes Tax- GDP and vice versa.
5. OPN Granger causes Tax- GDP and vice versa.
6. COR Granger causes Tax- GDP and vice versa.

Table 5. Pairwise Dumitrescu-Hurlin Panel Causality Tests

Null Hypothesis:	W-stat	Zbar-Stat.	P-Value	Decision
Tax- GDP does not homoge-neously cause GDPPC	5.2117	5.326	1.004e-07	Rejected
GDPPC does not homogeneously cause Tax- GDP	1.7377	-0.43493	0.6636	Accepted
Tax- GDP does not homoge-neously cause GOV	2.5268	0.87354	0.3824	Accepted
GOV does not homogeneously cause Tax- GDP	3.0799	1.7909	0.07332	Accepted
Tax- GDP does not homoge-neously cause INF	2.6324	1.0487	0.2943	Accepted
INF does not homogeneously cau-se Tax- GDP	4.8678	4.7558	1.977e-06	Rejected
Tax- GDP does not homoge-neously cause IS	4.7946	4.6344	3.58e-06	Rejected
IS does not homogeneously cause Tax- GDP	3.5887	2.6346	0.008423	Rejected
Tax- GDP does not homoge-neously cause OPN	5.6054	5.9789	2.247e-09	Rejected
OPN does not homogeneously cause Tax- GDP	7.0754	8.4166	2.2e-16	Rejected
Tax- GDP does not homoge-neously cause COR	4.4562	4.0732	4.637e-05	Rejected
COR does not homogeneously cause Tax- GDP	4.4756	4.1053	4.037e-05	Rejected

Source: own development using the R.

[3] It is a test statistic for heterogeneous panels based on the individual Wald statistics of Granger non causality averaged across the cross-section units.

Note: alternative hypothesis: Granger causality for at least one individual. On the whole, our findings emphasize the existence of a causal relationship between macroeconomic variables.

Dumitrescu-Hurlin panel causality tests, which are presented in Table 7., indicate that in the null hypothesis is accepted for the four variables (GDPPC→TAX-GDP; TAX-GDP→GOV; GOV→TAX-GDP; TAX-GDP →INF). For other variables the null hypothesis is rejected. Furthermore, a causal relationship from TAX-GDP to IS, OPN and COR seems to be clearly established, as well as from IS, OPN and COR to TAX-GDP.

Conclusions

This paper studies the statistical relationship and causal relationship between tax evasion and macroeconomics variables in CEE countries over the period 2004–2016. Important policy implications can be drawn from the analysis.

The estimates consistently suggest that government consumption, Institutional capacity and corruption do not appear as statistically significant. This allows us to believe that the CEE countries have no problem with institutional factors and are stable politically. GDP per capita the coefficient is very small: a huge amount of extra income per capita is required to make any substantial difference in the level of tax evasion. It is found that tax evasions is positively related to the inflation rate. The positive relationship between OPN and tax evasion are favors lower taxation of capital.

This findings are confirmed by causality tests, where they show a causal relationship from TAX-GDP to IS, OPN and COR seems to be clearly established, as well as from IS, OPN and COR to TAX-GDP.

It is important in the case of a large freedom of capital flows and harmonization of interest taxation and dividends paid out between entities within the European Union in the future, it would be necessary to use dynamic models to assess the impact of these phenomena and to expand with additional tax variables. It would also be worth to decompose the tax impact of a given country.

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