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The Optimal Tax Structure from GDP-growth Perspective

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Abstract

The tax multiplier in macroeconomics assumes a negative relationship between the volume of tax revenue in a country and its GDP. However, it may also be relevant to GDP growth whether the same volume of tax burden is levied in a different structure. Can the fiscal government stimulate the GDP growth by restructuring the tax revenues? The following study analyses the linkage between GDP growth rate and the structure of tax revenues. A database contains data from 25 EU countries which are open economies in the European single market. The period starts in 1996 and lasts until 2018. The Eurostat classification is used for tax types. Dynamic GMM tests are applied for GDP equations based on expenditure and output approach and extended with taxation category determinants. The conclusions are that tax structure based on consumer taxes on production and income tax can support the economic growth, meanwhile higher weight of social contribution is a destructive factor for income expansion. The policy recommendation is to reweight the tax structure toward indirect taxes from direct taxes if economic growth is a preference in the tax system in a trade-oriented open economy. Novelty of the research: Application of Arellano-Bond version of Dynamic GMM test, comparable results for Solow-Swan and augmented Cobb-Douglas approaches, the composition of database, the falsification and verification of statements of the existing literature.

Keywords: tax revenue, economic growth, European Union, Generalized Methods of Moments, Panel model.

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La estructura fiscal óptima desde la perspectiva del crecimiento del PIB

Resumen

El multiplicador de impuestos en macroeconomía supone una relación negativa entre el volumen de ingresos tributarios de un país y su PIB. Sin embargo, también puede ser relevante para el crecimiento del PIB si el mismo volumen de carga tributaria se recauda en una estructura diferente. ¿Puede el gobierno fiscal estimular el crecimiento del PIB reestructurando los ingresos tributarios? El presente estudio analiza el vínculo entre la tasa de crecimiento del PIB y la estructura de los ingresos tributarios. Una base de datos contiene datos de 25 países de la UE que son economías abiertas en el mercado único europeo. El período comienza en 1996 y dura hasta 2018. Para la clasificación fiscal se utiliza la clasificación de Eurostat. Se aplican pruebas dinámicas de GMM para ecuaciones del PIB basadas en el enfoque de gasto y producción y se amplían con determinantes de categorías impositivas. Se concluye que la estructura impositiva basada en impuestos al consumidor sobre la producción y el impuesto a la renta puede apoyar el crecimiento económico, mientras que un mayor peso de la contribución social es un factor destructivo para la expansión de los ingresos. La recomendación de política es reponderar la estructura tributaria hacia impuestos indirectos desde impuestos directos si el crecimiento económico es una preferencia en el sistema tributario en una economía abierta orientada al comercio. Como novedad de la investigación, se encuentra la aplicación de la versión Arellano-Bond de la prueba Dynamic GMM, resultados comparables para los enfoques de Solow-Swan y Cobb-Douglas aumentados, la composición de la base de datos, la falsificación y verificación de afirmaciones de la literatura existente.

Palabras clave: ingresos fiscales, crecimiento económico, Unión Europea, Métodos Generalizados de Momentos, modelo Panel.

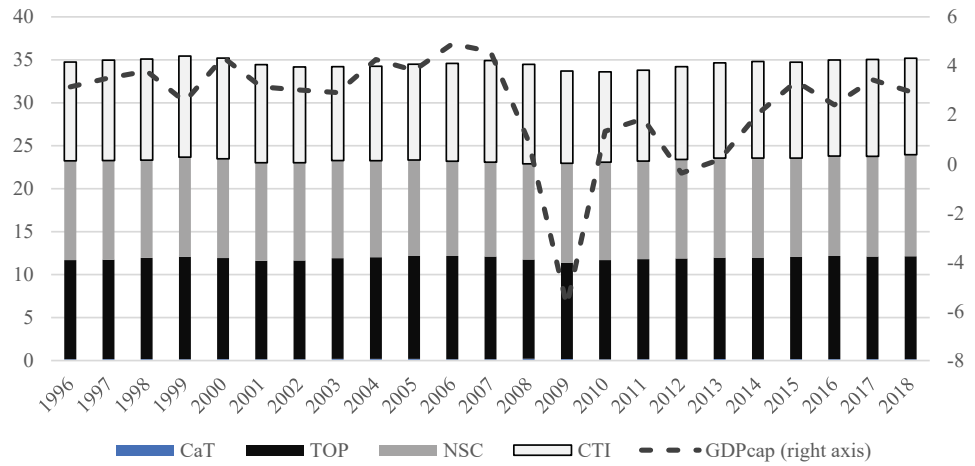
INTRODUCTION

The 20th century saw increases in the volume of public finances and expansion of the scope of government activities which demanded increased tax revenues. Beyond the question of the total volume of taxation, another policy dilemma concerns which types of taxes should be allotted greater weight in the revenues to achieve higher income opportunities in the future. The government expenditure which is a factor of GDP in the expenditure approach, it is backed by tax revenues (and deficit financing). Accordingly, there should be a correlation between economic growth and the tax revenue structure which is assumed by economics.

The impact on economic growth originated in public finances can be manifested by fiscal multipliers. This fact predetermines the empirical question whether the tax revenues can support economic growth, help recovery and counteract downturns, or they limit the growth opportunities. It is reasonable to assume that the answer is not independent of the structure of public revenue. It is therefore worth analysing the composition of tax revenues. Structural analysis of public revenues highlights the importance of taking into consideration the composition of fiscal austerity, or the distribution of tax refund, relief or credit.

Graphic 1.

EU25 average per capita GDP and average share of tax aggregates, 1995-2018



Source: Eurostat, authors' own elaboration.

Note: CaT – captal tax, TOP – tax on production, NSC – net social contribution, CTI – current tax on income, GDPcap – per capita GDP.

Empirical calculations on fiscal multipliers indicate that the effects of different tax types are of different intensity. This phenomenon implies the hypothesis, in relation to public finances, that the structure of the taxation has a significant impact on the GDP growth. This study accepts this assumption and aims to quantify the impact of the public tax revenue structure on growth of per capita GDP. (Graphic 1 demonstrates the co-movement of averages.)

The methodology of the study is built on a panel database applying the first differences GMM method to investigate EU countries which were conducted by using EViews software on the Eurostat classification (*Main national accounts tax aggregates*) of tax revenues applied for the period between 1996 and 2018 of EU25 countries. The research question was as follows: Do the various items of tax revenues by function accelerate or slow down the speed of economic growth?

The limitations of the research are as follows: The applied Eurostat dataset does not give an opportunity for analysis of certain specific tax types or in depth. The length of the time series limits the range of lagging. In policy practice, the tax systems serve alternative policy objectives which may prefer equity or other social and lobby interest to economic growth which can manifest in the structure of taxation. The model does not take other economic policy objectives into account other than the economic growth, thus trade-offs among different objectives are not calculated. The data set contains European high and medium developed economies participating in a single market. The results and conclusions are valid primarily for the group of economies which take part in this study. Differences in industrial or trade structure, various public, social or individual preferences can modify the efficiency of shift in tax structure. The result of the model does not give the general optimum weighting of a tax structure for countries. Finally, even though theoritical contributions were expected to be made, the results are not significant enough to draw conclusion about the capital taxes.

LITERATURE REVIEW

Related to impact of tax structure on economic growth, the baseline thesis was set by Barro (1990) who laid the base of models on public finance structure by extending endogenous growth models which included the tax-financing of government services which affected production. He found that growth rates fall with the imposition of direct and income taxes. Myles (2000) notes that empirical tests demonstrate

that the effect of tax on growth is very weak, although taxation theory has identified several channels of tax impact. He concluded that "the level of taxes is not that significant [...] but the structure of taxation is important" (Myles, 2000, p. 164). Commodity taxes were inelastic in demand and thus had no effect upon the growth rate (applying Ramsay rule principles). Barrios and Schaechter (2008) established that a non-distorting, but inciting revenue structure support the higher economic growth. However, there are '*trade-offs*' between economic growth and other objectives in tax policy. The validity of analysis about the structure of tax revenues can be based on the scientific detection of the role of government in improvement of potential growth as it is accentuated by Elekes and Halmai (2019). Cassette and Paty (2008) demonstrate with a GMM analysis that tax policy is a clash of competition among the 27 European countries. Consequently, not merely the total tax burden, but the structure of public revenues can be an important element for competitive business environment and thus for growth policy.

The literature about linkage between economic growth and tax structure is broad and well- argued as it is demonstrated in this article. Nevertheless, the current paper renews them with the Arellano-Bond version of Dynamic GMM test, the incorporation of expenditure and output approach on GDP equation, the composition of database, the falsification and verification of conclusions of the existing literature. Several types of econometric models can be found in the empirical papers about the correlation between public revenues and economic growth. Kneller et al. (1999) analysed 22 OECD countries in the period 1970-1995. Their panel regression employed pooled OLS, one-way fixed OLS, random GLS, two-way (country and time effects) fixed and random effects models, based on the log-likelihood and the adjusted R. Their conclusion on taxation was that "*distortionary taxation reduces growth, whilst non-distortionary taxation does not*" (Kneller et al, 1999, p. 171). In their models, increases in distortionary taxation resulted in lower economic growth, which is consistent with the Barro (1990) model. The magnitude of the estimated impact of taxation were sensitive to the process of 5-year averaging of the data which was considered to reflect uncertainty as to the exact impact on growth. Nonetheless, as a rule of thumb, they were able to establish that a 1% of GDP cut in distortionary taxes can increase the growth rate by 0.1-0.2% per year.

Wildmalm (2001) analysed the tax structure of 23 OECD countries in the time frame 1965-1990, with a linear regression and recognized that progressivity of taxation is destructive for growth. (The negative impact of increasing progressivity was confirmed by Rhee (2012), too, on tax changes.) Besides, Wildmalm measured

that higher share of labour income tax is negative, but higher share of tax on goods and services is positive on GDP growth. Lee-Gordon (2004) continued this line of research, examining 70 developing and developed countries in terms of cross-sectional growth multiple regression in OLS considering instrumental variables based on data covering the period from 1970 to 1997. They found a significant, negative correlation between corporate tax rates and economic growth. In the fixed effect panel regressions, increases in corporate tax rates resulted in lower future growth rates. Nevertheless, their emblematic conclusion is consonant with the paper just referred to, namely that cutting the corporate tax rate by 10 percentage points leads to an increase in the GDP growth rate of one to two percentage points.

Arnold (2008) performed his research in a period, ranging from 1970 to 2004. He focused on 21 OECD countries and applied an error correction regression model (ECM). The analysis concluded that income taxes are generally associated with lower economic growth compared to taxes on consumption and property, which allows the ranking of tax instruments in terms of their impact on growth. The paper found that "property taxes, and particularly recurrent taxes on immovable property, seem to be the most growth-friendly, followed by consumption taxes and then by personal income taxes. Corporate income taxes appear to have the most negative effect on GDP per capita" (Arnold, 2008, p. 2). outlined a proposal for a revenue-neutral, growth-oriented tax reform which would refocus tax revenues toward "recurrent property and consumption taxes and away from income taxes, especially corporate taxes" (Arnold, 2008, p. 2). The progressivity of personal income taxes was found to be negative for economic growth. McNabb (2018) repeated and extended the ECM analysis for 100 countries over the period between 1980 and 2013. He concluded that a shift in the tax structure from consumption and property taxes toward income taxes or a shift from consumption and property taxes toward personal income taxes or social contributions has a negative effect on long-run GDP growth. In this case, the novelty of the findings is that revenue-neutral increases in income taxes are associated with lower long-run GDP growth and that "revenue-neutral reductions in trade taxes have not always had positive effects" (McNabb, 2018, p. 173). That is why greater caution should be exercised in making tax reform recommendations.

Macek (2014) carried out a panel regression analysis of OECD countries for the period from 2000 to 2011 about the crowding out effect, based on the structure of total government spending and tax revenues. The analysis found that there is a negative correlation between economic growth and personal income taxes, corporate taxation and social security contributions, which means that these tax types can

lower GDP growth through their impact on savings and the capital market. However, this paper did not confirm the negative impact of property tax. In the same vein as previous studies, this paper confirmed that corporate tax and personal income taxes are the most "*harmful*" for GDP growth, based on the World Tax Index. Macek confirms the general conclusion that income taxes should be substituted with indirect taxes. Elshani and Ahmeti (2017) analysed the OECD countries in the period from 2002 to –2014 by applying random effect panel regression and confirmed the negative impact of personal income tax, although they found a positive coefficient for corporate income tax.

Regarding the USA, tax structure analyses were conducted by Kalaš et al. (2017) for the 1996-2016 period, by Bania et al. (2007) covering 1962-1997 period. Gale et al. (2015) researched the period from 1977 to 2011. All these studies confirmed the negative relationship between growth and tax types, but their results varied in their persuasiveness. Kalaš et al.'s research used a random effect panel and Bania et al. applied a dynamic fixed effect GMM estimator, and both confirmed the global panel results. They differed only in the significance atributted to specific tax types. Meanwhile, the third study, by Gale et al. applied an OLS model using five-year, non-connecting intervals which resulted in confusing coefficients. Kalaš et al. (2018) also repeated their random effect panel regression analysis, applying it to Serbia and Croatia using data from the period between 2007 and 2016. The conclusions of this later study contradicted those of the international results: corporate income tax, value added tax and social security contributions demonstrated a positive impact on GDP, while excise duties had a negative effect. Their results are questionable, however, since only value added tax had statistical significance. Engen and Skinner (1996) assumed about a U.S. tax reform that a 5-percentage point cut in marginal tax rates would have a positive impact on long-term growth rates. They tackled the problem through three methodological approaches by examining the historical record of the U.S. tax cuts and GDP, by considering the evidence on taxation and growth for a large sample of countries and by microlevel studies. They found 0.2 to 0.3 percentage point differences in growth rates related to tax reforms.

Ahmad and Sial (2016) ran an autoregressive-distributed lag (ARDL) bound test and an ECM test on Pakistani data between 1974 and 2010, which also appeared to confirm that indirect taxes are much more supportive of economic growth, while direct taxes and income taxes demand significant sacrifices of GDP growth.

There is a broad literature about the dilemma of cutting or not cutting tax on income and consumption. Most of them are interested only in particular tax types like personal or corporate income tax. (Mertens & Olea, 2018; Zidar, 2019; Ljungquist & Smolyansky, 2018; Gechert & Heimberger, 2022). For example, Alfò et al. (2022) used the Finite Mixture Model and built on Cobb-Douglas function (augmented by Arnold, 2008) to test the 1965-2010 tax and GDP data of 21 OECD countries. They managed to verify that massive, two-digit percentage point cuts of direct taxes on incomes can have measurable additional growth effects in the domestic production directly via economic activities and indirectly through technological development channels. These studies follow a perspective that differs from the view of the current paper since they focus on specific tax changes in different countries. Meanwhile, the tax structure approach applied in the current paper observes the composition of revenues from a holistic point of view and attempts to determine the good weighting of various tax types in the revenue structure for extension of economic output, unlike the studies about tax change which are curious about partial tax policy actions.

Stoilova (2017) made an OLS regression analysis on dataset which is very similar to the current research. There are partial overlaps regarding countries and time horizon. Generally, she established that every direct tax (PIT, property tax, tax on production and import) has a positive effect on growth. This raises the suspicion that in her OLS model it is much more a co-movement and not a one-way causality from the tax structure toward economic growth. Additionally, she found that VAT coefficient has a negative sign and describes an explanation which proves to be supportive of the current research results. She establishes that there are multi-rate VAT systems in the EU countries. Moreover, there are product specific exemptions from general tax rate which creates a complex, confusing composition of VAT revenue. Besides, she observed a cubic relationship curve between VAT and growth with a negative sign. That is why she drew the conclusion that higher VAT does not gain the economic benefits. The non-linear nature of VAT is confirmed by Gunter et al. (2019) who found that small rates have low impact closed to zero, while high VAT rates beyond a certain level behaves as the classic Laffer curve and turn to negative sign, namely destroying factor of economic growth. Gunter et al. (2019) concluded from VAT changes of a mix of 21 developed and 30 developing countries with various levels of rates that VAT overall has negative impact on GDP growth. They explicitly state that negative VAT multipliers in Europe are originated the high initial tax rates. The unfavourable assignation is refined about VAT impact by Acosta-Ormaechea and Morozumi (2021). Their thesis is that higher share and rates of VAT can be positive

merely in case of revenue neutral change, when labour taxes and other income taxes are reduced, as well as, the extension of VAT share is made not by raising the standard VAT rate, but by reducing exemptions and by increasing the preferential rates. These phenomena will have importance in explanation of current results which are based merely on developed European economies with relatively high, two-digit VAT rates, very likely on the negative slope of the Laffer Curve.

METHODOLOGY AND QUALITY OF DATA

Empirical model

An earlier paper we authored examined the impact of government expenditure by function (COFOG) on economic growth. (Kutasi & Marton 2020) In the present paper, this logical line of thought and analysis framework is extended, and the methodology implemented and adapted is similar to the research technique used in the government revenue analysis. The aim is to determine the impact of tax revenue structure on the growth ratio of GDP per capita. In the empirical analysis, the Dynamic Panel General Method of Moment (GMM) regression model was used. This procedure is in line with the panel methods found in the literature. To avoid the limitations of this method and to solve the endogeneity and causality problems, two estimation methods can be employed: The IV (Instrumental Variable) technique or the GMM method. In order to properly identify the effects of each tax revenue item, the dynamic first-differences GMM method was applied. GMM is a widely used estimation technique in the literature, although it has the disadvantage of omitting cross-sectional dependencies and structural breaks. The different types of the GMM estimation have been extensively considered in literature, e.g., Arellano and Bond (1991), Arellano and Bover (1995), Blundell and Bond (1998). The comparison of GMM and Fixed Effects Panel test results is an established practice in the empirical literature as demonstrated by Fidrmuc and Degler (2019), among others. In the empirical analyses, we use two approaches: Using the relationships of growth theory of the Solow-Swan model (the expenditure approach), and the endogenous growth approach based on Cobb-Douglas production function (the output approach) used by Arnold (2007) and Arnold (2008). The aim of the two theoretical approaches to growth is to examine the growth effects of the tax structure in different frameworks, as well as to ensure the robustness of our analyses.

Table 1.

Summary of empirical literature on tax structure

Study	Methodology	Database, region, period	Concrete results relevant to the impact of expenditure structure on GDP/capita growth
Barrios and Schaechter (2008)	Statistical analysis	COFOG, 24 industrialized countries, 1980-2005	Both direct and indirect tax has a negative impact. A bigger tax wedge results in lower growth.
Kneller et al. (1999)	Pooled OLS, fixed OLS, random GLS	World Bank data, 22 OECD states, 1970-1995	Distortionary taxes have a negative effect while non-distortionary taxes results were not significant.
Lee and Gordon (2004)	OLS, IV, Fixed Effect	World Tax Database, Office of Tax Policy Research, 70 developed countries, 1970-1997	Corporate tax and capital tax is negative.
Arnold (2008)	ECM	OECD Revenue Statistics 21 OECD countries, 1970-2004	CIT, PIT and capital tax is negative. Tax on consumption and property has a positive effect.
McNabb (2018)	ECM	ICTD UNU-WIDER Government Revenue Dataset, 100 countries, 1980-2013	The share of PIT and social contribution correlates negatively but the share of consumption tax correlates positively. Property tax correlation was positive in high and upper-middle income countries and negative in low-income countries.
Bania et al. (2006)	GMM (Arellano-Bond style)	U.S. Census of Governments, U.S. states, 1962-1997	The incremental effect of taxes spent on productive government activities is initially a positive linear effect, but eventually has a negative quadratic impact.
Elshani and Ahmeti (2017)	Cross-section time-series regressions	OECD Economic Outlook, OECD countries, 2002-2014	PIT and excise and customs duties have a negative effect; CIT and VAT a positive effect. Other taxes' correlation is not significant.
Gale et al. (2015)	OLS	Urban-Brookings Tax Policy Center's State and Local Finance Data Query System, US states, 1977-2011	Increasing taxes lowers economic growth in both the short and long term.
Kalaš et al. (2017)	Linear regression	OECD Revenue Stat., USA, 1996-2016	CIT was negative.
Kalaš et al. (2018)	Random and fixed effect panels	IMF data Serbia, Croatia, 2007-2016	Only VAT was significant, and it was positive.
Macek (2014)	Panel regression	OECD National Accounts Stat., OECD countries, 2000-2011	Negative GDP growth effect of CIT, PIT and capital tax. VAT is close to zero, but negative.
Ahmad and Sial (2016)	ARDL, ECM	Pakistani Statistics, Pakistan, 1974-2010	Indirect taxes have a negative effect, direct taxes have a positive one.
Stoilova (2017)	OLS, 2SLS	EU28, 1996-2014	PIT and social contribution, property tax, tax on production and import correlate positively with growth. VAT is negative on growth.
Widmalm (2001)	linear regression	23 OECD countries, 1965-1990	Progressivity of taxation and high share of labour income tax has negative effect on growth. Taxes on goods and services has correlates positively with GDP.

Source: Authors's own elaboration.

The first version, considering GDP formula is the expenditure approach. The dependent variable is the annual change of GDP per capita as a percentage, at constant prices. The independent variables are distributed into two groups for methodological reasons. The first group – related to the research question – contains the different types of main tax variables while the second group is made up of subcategories. The aim of this separation is twofold: On the one hand, it enables us to examine the impact of traditional budget revenue categories (for instance tax of products, current taxes on income and wealth, net social contributions and capital taxes) on GDP per capita, and on the other hand, the subcategories allow further in-depth analyses of the structure of taxes. The data source is the Eurostat database. The main national accounts tax aggregates and sub-categories as a percentage of GDP are as follows:

- Tax on products - ToP
    - Value added taxes – VAT
    - Other taxes on production – OTP
- Current taxes on income, wealth – CTI
    - Taxes on income – ToI
    - Other current taxes – OTC
- Net social contributions – NSC
    - Employers' actual social contributions – EASC
    - Compulsory employees' actual social contributions – CEASC
- Capital taxes – CaT

The other group of determinants contains other factors of GDP which shall be treated as so-called instrument variables in the GMM model and as control variables in the panel models. These variables can be divided into two parts, short-term and long-term GDP factors. These short-term factors are from the Eurostat 'GDP and main components' annual database and are expressed as a percentage of GDP:

- Household Consumption (Eurostat: P31_S14 Final consumption expenditure of households) – HC
- Investment (Eurostat: P51G Gross fixed capital formation) – GFCF

- Net Export (Eurostat: P6–P7 Exports of goods and services – Imports of goods and services) – NX

Related to the Solow-Swan economic growth model, some long-term GDP factors are also considered, as follows:

- General Government Deficit - DEF
- Population change – Demographic balance and crude rates at national level, Total population change (Eurostat) - POP
- Total Factor Productivity (OECD) - TFP

As the Eurostat database lacks the detailed tax structure of Estonia, Portugal and Sweden, the empirical test was executed on two overlapping databases. First, for the 25 EU countries including Estonian, Portuguese and Swedish data, but with a less detailed tax structure: ToP, CTI, NSC, CaT. In addition, the second database includes 22 EU countries, excluding Estonia, Portugal and Sweden, but with variables of a more detailed tax structure: VAT, OTP, ToI, OCT, EASC, CEASC, CaT.

In addition, a 'euro dummy variable' was used to examine the effects of European monetary integration. As the literature of integration economics attributes a growth effect to participation in the single currency zone, it is reasonable to apply this variable. The 'euro dummy' (eur_d) is 1 if the country was a eurozone member in the given year, and 0 if not.

Based on the above, the basic equation of the panel model of the research can be written as follows:

- Equation for EU25 database based on main tax categories:

$$gpd\_pc\_gr_{i,t} = \alpha + \beta_1 ln\ gdp\_pc\_cons_{i,t-1} + \beta_2\ ToP_{i,t} + \beta_3\ CTI_{i,t} + \beta_4\ NSC_{i,t} + \beta_5\ CaT_{i,t} + \beta_6\ HC_{i,t} + \beta_7\ GFCF_{i,t} + \beta_8\ NX_{i,t} + \beta_9\ DEF_{i,t} + \beta_{10}\ POP_{i,t} + \beta_{11}\ \mathrm{TFP}_{i,t} + \beta_{12}\ \mathrm{eur\_d}_{i,t} + u_{i,t} \quad [1]$$

- Equation for the EU22 database based on tax subcategories:

$$gpd\_pc\_gr_{i,t} = \alpha + \beta_1\ ln\ gdp\_pc\_cons_{i,t-1} + \beta_2\ VAT_{i,t} + \beta_3\ OTP + \beta_4\ ToI_{i,t} + \beta_5\ OCT_{i,t} + \beta_6\ EASC_{i,t} + \beta_7\ CEASC_{i,t} + \beta_8\ CaT_{i,t} + \beta_9\ HC_{i,t} + \beta_{10}\ GFCF_{i,t} + \beta_{11}\ NX_{i,t} + \beta_{12}\ DEF_{i,t} + \beta_{13}\ POP_{i,t} + \beta_{14}\ TFP_{i,t} + \beta_{15}\ eurd_{i,t} + u_{i,t} \quad [2]$$

where t – 1 is the lagged version of the given variable, i denotes each country, t is a time horizon and $u_{i,t}$ is an error term.

The basic equation of the GMM model of the two country groups, which include determinants, but instrument variables merely implicitly, it can be written as follows:

- Equation for EU25 database based on main tax categories:

$$gpd\_pc\_gr_{i,t} = \beta_1 \ln gdp\_pc\_cons_{i,t-1} + \beta_2 ToP_{i,t} + \beta_3 CTI_{i,t} + \beta_4 NSC_{i,t} + \beta_5 CaT_{i,t} + u_{i,t} \quad [3]$$

- Equation for EU22 database based on tax subcategories:

$$gpd\_pc\_gr_{i,t} = \beta_1 \ln gdp\_pc\_cons_{i,t-1} + \beta_2 VAT_{i,t} + \beta_3 OTP + \beta_4 ToI_{i,t} + \beta_5 OCT_{i,t} + \beta_6 EASC_{i,t} + \beta_7 CEASC_{i,t} + \beta_8 CaT_{i,t} + u_{i,t} \quad [4]$$

Moreover, the Arellano-Bond approach was used in the GMM analysis which means that the first lag of the dependent variable ($gpd\_pc\_gr_{i,t-1}$) was included as an instrument. Additional instrument variables such as household consumption, gross fixed capital formation (GFCF), net exports, population change, and total factor productivity are also included in the model.

The second version applied for GDP function is the output approach which is based on the Cobb-Douglas production function, where we considered the models used in Arnold (2007) and Arnold (2008) as a starting point for the analyses. Arnold (2008) examines the relationship between tax revenues and economic growth with an error correction model (ECM). The model is based on the approach of Cobb-Douglas production function, and the empirical analysis covers growth factors with the following variables: Physical capital, human capital, inflation, trade openness, working age population.

The estimations are performed by the same methods: Panel methods and dynamic GMM methods. The following elements are considered to be control and instrument variables:

- Physical Capital – PHYC, same GFCF as in the previous approach.
- Human Capital – HUC, the average number of years spent in school by those over 25 years of age.
- Inflation – INF, harmonized index of consumer prices.
- Trade Openness – TO, Exports of goods and services + Imports of goods and services, in % of GDP.
- Change of working age population – WAP, change of the working age population between 25 and 64 years

Based on these, the complete equations can be written as the followings:

- Equation for the EU25 database based on main tax categories:

$$gpd\_pc\_gr_{i,t} = \alpha + \beta_1 \, ln \, gdp\_pc\_cons_{i,t-1} + \beta_2 \, ToP_{i,t} + \beta_3 \, CTI_{i,t} + \beta_4 \, NSC_{i,t} + \beta_5 \, CaT_{i,t} + \beta_6 \, PHYC_{i,t} + \beta_7 \, HUC_{i,t} + \beta_8 \, WAP_{i,t} + \beta_9 \, INF_{i,t} + \beta_{10} \, TO_{i,t} + \beta_{12} \, eurd_{i,t} + u_{i,t} \quad [5]$$

- Equation for the EU22 database based on tax subcategories:

$$gpd\_pc\_gr\_{i,t} = \alpha + \beta_1 \, ln \, gdp\_pc\_cons_{i,t-1} + \beta_2 \, VAT_{i,t} + \beta_3 \, OTP + \beta_4 \, ToI_{i,t} + \beta_5 \, OCT_{i,t} + \beta_6 \, EASC_{i,t} + \beta_7 \, CEASC_{i,t} + \beta_8 \, CaT_{i,t} + \ + \beta_9 \, PHYC_{i,t} + \beta_{10} \, HUC_{i,t} + \beta_{11} \, WAP_{i,t} + \beta_{12} \, INF_{i,t} + \beta_{13} \, TO_{i,t} + \beta_{14} \, eurd_{i,t} + u_{i,t} \quad [6]$$

For GMMs, the equations and independent variables remained unchanged and are as follows:

- Equation for the EU25 database based on main tax categories:

$$gpd\_pc\_gr\_{i,t} = \beta_1 \, ln \, gdp\_pc\_cons_{i,t-1} + \beta_2 \, ToP_{i,t} + \beta_3 \, CTI_{i,t} + \beta_4 \, NSC_{i,t} + \beta_5 \, CaT_{i,t} + u_{i,t} \quad [7]$$

- Equation for the EU22 database based on tax subcategories:

$$gpd\_pc\_gr\_{i,t} = \beta_1 \, ln \, gdp\_pc\_cons_{i,t-1} + \beta_2 \, VAT_{i,t} + \beta_3 \, OTP + \beta_4 \, ToI_{i,t} + \beta_5 \, OCT_{i,t} + \beta_6 \, EASC_{i,t} + \beta_7 \, CEASC_{i,t} + \beta_8 \, CaT_{i,t} + u_{i,t} \quad [8]$$

However, the instruments are different compared to the previous models, and in this case the following instruments are included in the analysis: Physical capital, human capital, working age population, inflation and trade openness. In addition, the lagged value of the dependent variable is also used as an instrument.

The model versions are the followings:

- Model 1 is GMM test in an expenditure approach, on 25 countries, main tax aggregates.
- Model 2 is GMM test in an expenditure approach, on 22 countries and tax sub-categories.
- Model 3 is GMM test in an output approach, on 25 countries, main tax aggregates.
- Model 4 is GMM test in an output approach, on 22 countries and tax sub-categories.

To increase the statistical significance of the results, the assumption of lagging effect is implemented in the methodology, thus the model versions are also tested with lagged determinants. The optimum result is published with the broadest statistical significance of the determinants.

Data

The focus of the analysis is on the European Union member states. Three member states had to be excluded: Malta and Croatia because of missing data and Luxemburg because of its outlier nature. The panel data is drawn from 24 EU countries and the United Kingdom between 1996 and 2018. Table 2 presents the descriptive statistics of the variables. The stationarity of each time series was tested with the Levin-Lin-Chu panel unit root test (Levin et al. 2002) before performing the various model examinations. Based on the results of panel unit root tests, some of the variables (HC, NX, HUC and TO) cannot be considered stationary, hence the first differenced values were applied in the models.

RESULTS

In the assessment of results in Table 3 (see further below), the focus is on the coefficients calculated by the GMM model. In the GMM model, the Arellano-Bond (AR) autocorrelation test was applied to examine first and second order autocorrelation. Moreover, the Hansen-J test was used to eliminate the over-identification of instruments.

Based on the panel data of 25 EU+UK countries regarding the period from 1996 –to 2018 using the main Eurostat tax aggregates, it can be established that tax structure is relevant in the determination of per capita GDP growth rate. The GMM models – both the expenditure and the output approach – verified the statistical significance of consumer taxes on products (ToP), current tax on income and wealth (CTI) and net social contribution (NSC) at a level of 1%, without applying a lagged model. While the share of ToP and CTI positively affects growth, vis-á-vis the share of NSC the results are negative on GDP. The robustness of this conclusion is confirmed for NSC by the fixed/random effect panel model versions.

Table 2.

Descriptive statistics of variables

Variable	Obs.	Mean	Standard Deviation	Min	Max	Data source
GDP per capita (%) at constant prices	575	2.45	3.65	-14.27	23.99 (Ireland – 2015)	Eurostat
GDP per capita (PPP, constant 2017 international dollar)	575	35,916.58	12,637.07	9,680.275	86,781.39	World Bank
Tax on products, % of GDP	575	11.75	1.69	6.8	16.8	Eurostat
Value added taxes, % of GDP	575	7.31	1.28	0.0	10.4	Eurostat
Other taxes on production, % of GDP	575	1.81	2.04	0.0	12.0 (Sweden – 1998,1999)	Eurostat
Current taxes on income, wealth, % of GDP	575	11.25	5.17	4.4	33.2 (Denmark – 2014)	Eurostat
Taxes on income, % of GDP	575	10.68	4.97	4.3	31.9	Eurostat
Other current taxes, % of GDP	575	0.56	0.47	0.0	2.7	Eurostat
Net social contributions, % of GDP	575	11.44	4.25	0.9	20.0	Eurostat
Employers' actual social contributions, % of GDP	575	6.42	2.65	0.0	12.1	Eurostat
Compulsory employees' actual social contributions, % of GDP	542	3.31	1.99	0.0	9.4	Eurostat
Capital taxes, % of GDP	575	0.16	0.21	0.0	1.6	Eurostat
Household Consumption/GDP	575	76.46	6.53	42.9	91.7	Eurostat
Net Export/GDP	575	0.42	6.54	-20.7	33.1	Eurostat
Government deficit % of GDP	575	-2.62	3.41	-32.1 (Ireland – 2010)	6.9	Eurostat
GFCF/GDP	575	22.36	4.15	4.5	37.3	Eurostat
Population change (%)	575	0.16	0.72	-2.26	2.9	Eurostat
Total Factor Productivity (%)	564	2.12	2.86	-11.4	19.87	OECD
Human Capital (years)	575	11.07	1.44	6.5	14.1	UNDP Human Development Reports
Changes of working Age Population (%)	575	0.00	0.01	-0.04	0.04	authors' calculation based on Eurostat data
Inflation (%)	575	1.05	0.44	0.93	11.42	World Bank
Trade Openness (%)	575	99.17	38.97	37.5	226.8	authors' calculation based on Eurostat data

Source: Authors' own calculation based on Eurostat, OECD and World Bank data.

The significance of this impact was not, however, proved by the unlagged model versions, which considered the detailed structure of taxes with sub-categories and a restricted number (22) of countries. Only employees' social contributions (CEASC) seemed to be significantly negative without lagging, and then only in the GMM test. For this reason, different lags were tested. Regarding the statistical significance at a level of 1%, the most optimum version is when VAT, OTP and capital tax are lagged by two quarters, ToI and EASC by one quarter, while in contrast OCT and CEASC remain unlagged. The lagged version of the GMM tests showed strong significance of VAT, OTP, EASC and ToI, at 1%, and OCT at 5% level in both approaches, whereas the significance of CEASC was weaker in the lagged version.

Capital tax (CaT) remains a puzzle. The unlagged versions do not indicate any statistical significance, although the lagged versions showed a significance of only 10%. It is thus not justified to draw conclusions about the impact of CaT share on growth.

CONCLUSION AND DISCUSSION

This study investigated the effect of government tax revenues structure on the GDP growth of 25 EU countries, based on their Eurostat classification and analysing panel data over the period 1996-2018. The research question was whether the types of tax items as a structure of the public budget revenues have a significant deterministic impact on growth. As a general theoretical hypothesis, it was assumed that a correlation could be measured. The study used the GMM model, in accordance with the empirical literature related to the research question. The results are strongly concordant with previous studies referred to in the literature review. The tax types and their structure thus clearly had an effect on the GDP growth rate of member states of the EU.

The novelty of the research content in the paper are the following: First of all, it creates opportunity to compare the model results based on the generally used Solow-Swan model (expenditure approach) and the more rarely applied Cobb-Douglas model (output approach) augmented by Arnold (2008). Furthermore, the regression tests were executed with the Arellano-Bond version of Dynamic GMM test, as a recently omitted solution. Besides, the composition of database and time frame is specific. Finally, the falsification and verification of statements in the existing literature raises the robustness of previous authors' results.

Table 3.

Results of regression models without and with lags

Variables	GMM without lags				Variables	GMM with lags			
	expenditure approach		output approach			expenditure approach		output approach	
	Model 1 - EU25	Model 2 - EU22	Model 3 - EU25	Model 4 - EU22		Model 1 - EU25	Model 2 - EU22	Model 3 - EU25	Model 4 - EU22
ln(GDP_pc_cons$_{t-1}$)	-1.167945 **	0.599564	-1.895314 ***	-0.084717	ln(GDP_pc_cons$_{t-1}$)	-0.181681	3.954087	-0.423437	3.035897
ToP	0.853057 ***	-	0.878229 ***	-	ToP	0.364453 ***	-	0.51496 3 ***	-
VAT	-	0.658224	-	0.565600	*VAT (-2)*	-	-1.571231 ***	-	-1.6074 ***
OTP	-	0.272694	-	0.100957	*OTP (-2)*	-	3.907267 ***	-	4.078338 ***
CTI	0.183187 ***	-	0.262798 ***	-	CTI	0.557070 ***		0.473263 ***	
ToI	-	0.395332**	-	0.326395	*ToI (-1)*	-	-0.682441 ***	-	-0.71418 ***
OCT	-	-5.871946*	-	-6.763000	*OCT*	-	-5.053263 **	-	-4.627170 **
NSC	-1.66749***	-	-1.586376 ***	-	NSC	-1.88339 ***		-1.898216 ***	
EASC	-	-0.745041	-	-0.581468	*EASC (-1)*	-	1.115088 ***	-	1.18903 ***
CEASC	-	-0.49948***	-	-0.52303 **	*CEASC*	-	-1.591531 **	-	-1.249463
CaT	-0.622648	2.890558	3.260748	3.826924	CaT (-2)	-4.148650 *	7.829042 *	0.217395	7.668223
No. of observation	541	476	541	481	No. of observation	495	434	500	437
Hansen J test	0.299898	0.232189	0.447148	0.229100	Hansen J test	21.57295	16.59510	22.97059	16.10436
Instrument rank	29	22	25	22	Instrument rank	29	22	25	22

Source: Authors' own calculations based on Eurostat, OECD and World Bank data;

Note: significance: *** at 1 %, ** at 5%, * at 10%; Hansen J test denotes the result of the p-value of a Hansen J test of overidentifying restrictions. Estonia, Portugal and Sweden are not included in model versions EU22.

The current results are consistent with the thesis by Myles (2000), which states that the structure of taxation is important in respect to economic growth. The conclusions also support the assumption by Barrios and Schaechter (2008), who established that both direct and indirect taxes hinder economic growth. This was confirmed for both the main classes of taxes and the detailed classification of taxes. The results of the panel analysis imply that a higher weight of tax on products has a positive impact on growth, with the exception of VAT. Other taxes on production had a positive impact as can be deduced from the sign of the coefficients performed by the lagged GMM model versions. In addition, it was found that a higher proportion of income taxes and labour related contributions is harmful for growth in the EU25 group of countries examined.

The negative sign of VAT seems to be surprising beside the positive impact of overall indirect and other indirect taxes. First of all, it shall be established that the current result is in line with and confirm the calculations made by Stoilova (2017), Gunter et al. (2019) and Acosta-Ormaechea and Morozumi (2021). The explanation can be found in these latter studies – as it was explained in the literature review. On the one hand, the surveyed European economies have had originally high initial VAT rates which settled them to the negative slope of the Laffer Curve just like Stoilova (2017) and Gunter et al. (2019) explained by the results of their research. On the other hand, most of the countries of the dataset did not restructure their tax revenues from income taxes toward VAT in a revenue-neutral way, which is an essential condition of positive impact of higher VAT revenue share on economic growth according to Acosta-Ormaechea and Morozumi (2021).

The current models were not able to conclusively confirm the correlation between capital taxes and GDP growth. The thesis by Lee and Gordon (2004), Arnold (2008), McNabb (2018) and Macek (2014), namely that capital tax has a negative impact on economic growth was supported only by GMM model 1 with two quarters lags and the random effect panel model 8 with four quarters lags. Since the social contribution coefficients are understood as representing a tax burden on labour, they have an unequivocally negative effect, similarly to income tax. Macek (2014) explicitly states the same about social contributions. The results about current taxes on income and wealth are in line with every paper reviewed in the current study, except for Ahmad and Sial (2016) who found a positive impact for direct taxes. The current research cannot confirm the positive impact of the share of property tax – which was found by McNabb (2018) and Arnold (2008) – because the breakdown of the revenue data employed did not distinguish the category.

Overall, the current results support the policy conclusion that for the purpose of boosting GDP growth in a developed economy, the structure of public tax revenues should be weighted and shifted towards tax on products (indirect taxes). Furthermore, increasing the level of employers' social contributions has an unambiguously negative effect on growth, therefore these should be reduced as much as possible and such revenue should be derived from indirect taxes. It may also tentatively be concluded from the coefficients with at least a 10% confidence interval that, the tax burden on capital and income should perhaps be relocated to other taxes. The contradiction between the signs of employers' and employees' social contribution can be resolved with the source of tax revenue. The employees' social contribution drains income from household consumption and savings. If this amount remained in the disposable income of the households, merely a part of it would be additional GDP through household consumption as it is determined by the marginal consumption propensity, but the rest could become savings in an open economy. Compared to private household spending, the collected employees' social contribution is spent completely by the government, consequently the full amount will extend the government spending, another part of GDP. In contrast to employees' payment, the employers' social contribution tapers off the corporate financial sources for investment, which has a usually stronger multiplying effect on GDP than the government spending.

The policy recommendations are the following based on the research results:

- Tax structure shifts are a relevant tool to achieve the policy mix objectives. Even without pressure of a fiscal crisis, it can be a growth policy option to restructure the overall tax burden.
- Generally, it is worth to reweight the tax structure toward indirect taxes from direct taxes if economic growth is a preference in the tax system in a trade-oriented open economy.
- General raise of VAT destroys the growth opportunities. If tax structure is intended to shift toward indirect taxes mostly through higher VAT revenue, it is preferable to cancel the exemptions and diminish the range of products under preferential rates. Tax increase of revenue from higher standard VAT rate can be supportive for economic growth merely in case of a low initial tax rate. In other cases, in which the European economies belong to, the share of other indirect taxes (other taxes on production) is recommended to be risen. The latter category contains the following tax

types by definition: Taxes on the ownership or use of land, buildings, taxes on the use of fixed assets, taxes on the total wage bill and payroll taxes. taxes on international transactions, taxes paid by enterprises for business and professional licences, taxes on pollution resulting.

- In the case of social contributions (social insurance), the employers' share is recommended to be reduced, while employees' burden does not endanger the growth, if it is a bigger amount among the total revenues of the government. Of course, the spreading of the total social insurance tax burden on broader crowds of employees can compose higher revenue volume as well as lower rates. Nevertheless, other aspects, e.g., equity can limit the employees' social contribution.

Further research endeavors could use a different growth objective and measure the extend of the trade-off to which tax systems serve economic growth. About the current database and group of countries, research can be repeated with tax change approach. Internal structure of tax types, like progressive vs. flat rate, exemptions and preferential rates and so on. The current methodology can be repeated with a more detailed, more specific tax types of datasets. Besides, this research procedure is completed and ready to test the impact of tax policy actions, not merely on GDP, but other macroeconomic indicators, as well. Finally, it can be interesting to find the tipping point when the revenue from a tax type turns to follow a Laffer Curve on the diminishing revenue slope.

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