

**I. ARTICLES**

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**IMPACT OF EU TAXATION SYSTEMS ON 1998-2004  
ECONOMIC GROWTH**

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This article presents a review of theoretical and empirical tax competition and institutional competition as a basis for constructing and testing an original endogenous growth model. The corporate and personal tax systems in the European Union members are very different and complex. For many years they have motivated countries to modify their systems and offer incentives, e.g. lower tax rates and tax breaks for creating jobs to attract businesses in order to improve economic growth. In turn, these processes have attracted the attention of government officials, politicians and researchers to study their impact on growth, among them, Tiebout (1956), Brennan and Buchanan (1980), Zodrow and Mieszkowski (1986) and North (1992). Their work provided conflicting results, while empirical studies increased ambiguity. The author of this work hopes to add another dimension to that literature, with an empirical model providing additional support for positive effects of tax competition and institutional tax variety among EU members on their economic growth.

**Keywords:** tax competition, Tiebout, Leviathan hypothesis, Zodrow-Mieszkowski model

**1. INTRODUCTION**

The goal of this article is to assess the impact of tax competition among European Union member countries and institutional tax systems on economic growth. To do so, the author utilized an endogenous growth model, which was originally presented by Solow (1956) and later developed by Mankiw, Romer and Weil (1992). For the purpose of measuring the impact of tax competition in corporate income taxes and social security contributions over the years 1998-2004 on economic growth quantified by gross domestic product per capita, the author used a further transformation of the model by Feld, Kirchgassner and Schaltegger (2005), while also making few of her own.

The publication begins with a discussion of corporate and personal income taxation structures within the EU members. It then progresses to theoretical and empirical studies of linkages between tax competition and institutional systems on one hand and economic growth on the other. Further, it presents

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origin and modifications of the econometric modeling as well as the variables and data employed. In conclusion, the author shows the results of her study.

## 2. TAX SYSTEMS IN EUROPEAN UNION COUNTRIES

### 2.1. Corporate income tax

Despite official remarks and scientific studies suggesting that corporate tax systems of European Union members are becoming similar, in fact they still differ a lot. This can be explained by various rules being used by countries as generally accepted accounting principles (GAAP) and the range of tax reliefs and tax credits being offered (e.g. accelerated depreciation allowances, tax breaks for creating jobs, tax incentives to locate in deprived areas), which often result in large discrepancies between the statutory and effective corporation tax (Joumard, 2001, p. 34). The reasoning behind such offerings is threefold: (1) they favour companies in fixed capital- and labour-intensive industries, (2) they help small and medium enterprises to establish themselves in their markets or, in other words, support entrepreneurial activities and (3) they act to attract foreign direct investment, especially into backwarded areas or underdeveloped industries (Joumard, 2001, p. 34-35).

In the EU, companies are taxed according to the country's taxation laws, though in some instances EU law provides additional guidelines. There is a number of taxes that may apply to a business depending on its location; they include (1) corporation tax, (2) legal entity tax, (3) occupational tax, (4) payroll tax, (5) crisis fee and (6) solidarity fee. While in some countries a business operating under the limited liability clause is considered a corporation and taxed according to corporate taxation laws, in other nations corporations and legal entities are separate organizations and so taxed differently. Since there are underlying reasons for the large differences in current taxation rules, the only viable way to compare and contrast these systems is to present them separately. Therefore, Table 1 presents the number of income levels with corresponding nominal and effective rates as well as some brief explanations. Insofar as the tax rates differ a lot between member countries, they have also changed through the years. Table 2 presents historical changes in nominal tax rates over the period 1980-2005. In general, over the last fifty years, rates have declined in all fifteen members, while over 1995-2005 period rates decreased in all but four nations, which are Spain, Malta, Slovenia, and Sweden. It is important to note that nominal rates may differ from effective rates due to additional taxes levied (see Table 1) as well as tax allowances and credits.

Table 1  
Corporate income tax in European Union member countries

Country	Number of income levels	Income level – nominal rate (effective rate)	Additional information
Austria	-	linear rate – 25% (28%)	communal tax 3%, payroll tax 4.5%, association tax 3%
Belgium	-	linear rate – 33% (33.99%)	crisis tax 3%; for businesses earning less than €322,500 preferential rates are: 22.98%, 31.93%, 35.54%
Cyprus	-	linear rate – 10% (10%)	for organizations with public equity the rate is 25%
Czech Republic	-	linear rate – 24% (24%)	
Denmark	-	linear rate – 28% (28%)	
Estonia	-	linear rate – 28,21 % (28,21%)	rate of 0% for reinvested profits, rate of 28,21% for distributed income
Finland	-	linear rate – 26% (26%)	
France	2	income below €38,120 – 15% (15,45%) income above €38,120 – 33,33% (34,45%)	additional tax 3% of tax payable, payroll tax 0.5%, freelance workers pay occupational tax
Germany	-	linear rate – 25% (max. 38.29%)	solidarity tax 5.5%, local tax on business operations 22% to 25.75% (16.18% of that tax deductible from taxable income)
Great Britain	5	rates of 0%, 0%-19%, 19%, 19%-30%, 30% depending on the income level	
Greece	2	corporations – 29% (29%) other businesses – 22% (22%)	
Holland	2	income below €22,689 – 25.5% (25.5%) income above €22,689 – 29.6% (29.6%)	
Hungary	-	linear rate – 16% (16%)	additional payroll tax and local tax with various rates; companies can use a special tax system EVA with a rate of 15%
Ireland	-	linear rate – 12.5% (12.5%)	preferential temporary rate of 0% or 10% for new businesses and rate of 25% for companies in mining and fuel industries
Italy	-	33% (36.25%)	regional tax on business operation 2.25% (+/- 1%)
Latvia	-	linear rate – 15% (15%)	small enterprises can apply deduct 20% of accrued tax
Lithuania	2	income below LTL 500,000 – 13% (13%) income above LTL 500,000 – 15% (15%)	social tax only in 2006 (of 4%) and 2007 (of 3%)

Table 1 continues on the next page

Table 1 continued

Luxembourg	-	linear rate – 22% (30.38%)	employment fund 4%, local tax on business operation 7.5% or 6.98%
Malta	-	linear rate – 35% (35%)	
Poland	-	linear rate – 19% (19%)	
Portugal	-	linear rate – 25% (27.5%)	local tax maximum 2.5% small companies can use a preferential rate of 20%
Slovakia	-	linear rate – 19% (19%)	
Slovenia	-	linear rate – 25% (25%)	payroll tax 3.8% to 14.8%; special economic zones with a rate of 10%
Spain	2	SME income below €90,151.81 – 25% (27%) SME income above €90,151.81 – 30% (32%) other businesses – 35% (37%)	local tax and association fee 0.01% to 0.75%, regional tax due to business operation 1.29% to 1.35%
Sweden	-	linear rate – 28% (28%)	possibility of establishing a reserve for up to six years, then a rate of 25% applies

Source: Wach, K. (2005), *Systemy podatkowe krajów Unii Europejskiej*, p. 52-55

Table 2

Nominal tax rates in European Union member countries, 1980-2005 (in %)

Country	1980	1985	1990	1995	2000	2001	2002	2003	2004	2005
Austria	61	61	61	34	34	34	34	34	34	25
Belgium	48	45	43	40.17	40.17	40.17	40.17	33.99	33.99	33.99
Cyprus	NA	NA	NA	25	29	28	28	15	15	10
Czech Republic	NA	NA	NA	41	31	31	31	31	28	26
Denmark	37	50	40	34	32	30	30	30	30	28
Estonia	NA	NA	NA	26	31.58	31.58	31.58	31.58	31.58	31.58
Finland	50	50	40	25	29	29	29	29	26	26
France	50	50	36.7	36.7	36.66	35.33	34.33	34.33	34.33	34.33
Germany	64	61	61	56.8	51.6	38.29	38.29	38.29	38.29	38.29
Great Britain	52	40	35	33	30	30	30	30	30	30
Greece	49	49	46	40	40	37.5	35	35	35	32
Holland	46	42	35	35	35	35	34.5	34.5	34.5	31.5
Hungary	NA	NA	NA	19.6	18	18	18	18	16	16
Ireland	45	50	43	40	24	20	16	12.5	12.5	12.5
Italy	36.3	47.8	47.8	52.2	41.25	40.25	40.25	38.25	37.25	37.25
Latvia	NA	NA	NA	25	25	25	22	19	15	15
Lithuania	NA	NA	NA	29	25	24	15	15	15	15
Luxembourg	45.5	45.5	39.4	40.9	37.45	37.45	30.38	30.38	30.38	30.38
Malta	NA	NA	NA	35	35	35	35	35	35	35
Poland	NA	NA	NA	40	30	28	28	27	19	19
Portugal	51	51	39.6	39.5	30	28	28	27	19	19
Slovakia	NA	NA	NA	40	29	29	25	25	19	19
Slovenia	NA	NA	NA	25	25	25	25	25	25	25
Spain	33	33	35	35	35	35	35	35	35	35
Sweden	40	52	52	28	28	28	28	28	28	28

Source: Wach, K. (2005), *Systemy podatkowe krajów Unii Europejskiej*, p. 50

## 2.2. Labour taxes

Although making tax allowances and credits as well as providing a low corporate tax rate are primary ways to encourage businesses to operate in a specific member country, since companies are also burdened by the social security contributions and to some extent personal taxes payable by their employees, it is important to consider the latter when discussing tax competition among member states. Carey and Tchilinguirian (2000) estimated that the average effective tax rate on labour is much higher in Europe than in the United States and Japan. In 1997, in the EU it reached around 38%, compared with 24% in the U.S. and also in Japan. In addition, according to Joumard (2001), the average effective tax wedge in EU members at the wage level of an average production worker was approximately 40%, while in the U.S. it was about 30% and in Japan around 24% (p. 10). These statistics show that labour in Europe is more costly for companies, which may undermine their competitive abilities. However, countries realized this impact, so they began to cut marginal rates on labour income, actions targeted at increasing hiring and thus employment (e.g. Austria, Germany) or at redistributing some portions of income from the wealthy to the poor (e.g. Denmark, France; Joumard, 2001, p. 13).

Just as corporate tax systems in the EU, personal tax systems are very complex and diverse. Various countries have a varying number of income levels at differing rates. In general, most members use progressive systems with the exception of Estonia, Slovakia, Lithuania. Only two income divisions are present in Hungary and Latvia, while Luxembourg has the greatest number with sixteen strata. Personal income taxes can be levied at national, regional (state) and local (municipal) levels. Wach (2005) presented four general rules governing such taxation: (1) taxes are levied on entire annual income, (2) in most countries taxation is progressive, (3) in most countries there is an amount earned free of tax, (4) in most countries different taxing rules apply to residents and non-residents (p. 40). For a more detailed look at member states tax systems see Table 3.

Table 3  
Personal income tax in European Union member countries

Country	No. income levels	Income level (when available) – nominal rates	Amount free of tax	Additional information
Austria	4	€0-€10,000 – 0% €10,000-€25,000 – 0%-23% €25,000-€51,000 – 23%-33.5% €51,000 – 50%	€10,000	progressive
Belgium	5	25%, 30%, 40%, 45%, 50%	€6,800	progressive depending on the annual income amount; city tax 10% and 1% additional Brussels city tax
Cyprus	4	0%, 20%, 25%, 30%	€10,000	progressive depending on the annual income amount
Czech Republic	4	12%, 19%, 25%, 32%	€1,265	progressive depending on the annual income amount
Denmark	3	national: work-related 5.5%, 6%, 15%, capital-related 28%, 43%, 30%; regional: 11.4% to 12.5%; local: 16.5% to 23.5%	€4,940	national, regional and local taxes depending on annual income amount and whether it is income from work or capital
Estonia	-	linear rate – 24%	LLT 1,305	
Finland	6	national: work-related 0%, 9%, 14%, 19.5%, 25.5%, 32.5%, capital-related 28%; local: 16% to 20%	€12,000	national and local taxes depending on annual income amount and whether it is income from work or capital
France	5	0%, 5.5%, 14%, 30%, 40%	€4,334	progressive depending on the annual income amount
Germany	4	0%, 15%-23.97%, 23%.97%-42%, 42%	€7,664	progressive depending on the annual income amount but linear within a single level; solidarity tax 5.5%
Great Britain	3	10%, 22%, 40%	£6,880	progressive depending on the annual income amount
Greece	4	0%, 15%, 30%, 40%	€10,000	progressive depending on the annual income amount

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Table 3 continued

Holland	4	34.15%, 41.45%, 42%, 52%	€1,825	progressive depending on the annual income amount; rates include social security contributions, thus at tax-free level (0%) social security paid is 2.45% or 9.75%; tax on capital is 25%
Hungry	2	18%, 38%	HUF442	progressive depending on the annual income amount
Ireland	2	20%, 42%	€1,520	progressive depending on the annual income amount
Italy	3	23%, 33%, 39%	€7,500	progressive depending on the annual income amount; above €100,000 added solidarity fee of 3%, regional tax of 0.9% to 1.4% and city tax of 0.5% of taxable income
Latvia	-	linear rate – 25%	-	
Lithuania	-	15% income from dividends, rent, copyright, individual business activities and of mariners and athletes; from other income 33% (from Jan. 1 <sup>st</sup> to Jun 30 <sup>th</sup> ), 27% (from Jul. 1 <sup>st</sup> to Dec. 31 <sup>st</sup> )	€1,000	linear depending on the income's origin
Luxembourg	17	0%-38%	€9,750	progressive depending on the annual income amount;
Malta	6	0%, 15%, 20%, 25%, 30%, 35%	LM7,130	progressive depending on the annual income amount;
Poland	3	19%, 30%, 40%	PLN 698	progressive depending on the annual income amount;
Portugal	6	10.5%, 13%, 23.5%, 34%, 36.5%, 40%	-	progressive depending on the annual income amount;
Slovakia	-	linear rate – 19%	-	
Slovenia	5	16%, 33%, 37%, 41%, 50%	11% of taxable income	progressive depending on the annual income amount;
Spain	5	15%, 24%, 28%, 37%, 45%	€3,400	progressive depending on the annual income amount; rates include national and local taxes
Sweden	3	national: work-related 20% or 25%, local: 27% to 34%	€32,850	national and local taxes depending on annual income amount and whether it is income from work or capital

Source: Wach, K. (2005), *Systemy podatkowe krajów Unii Europejskiej*, p. 41-44

### 3. EFFECTS OF TAX COMPETITION ON ECONOMIC GROWTH

#### 3.1. Theoretical results

Two different economic schools of thought – institutional economics and macroeconomics – have studied the impact of tax competition on growth. Each venue developed its theories and conducted empirical testing of models. In order to understand the complex relationship between tax competition, institutional systems and economic growth, this section will briefly examine theories, while the following section will present their empirical results.

Douglass North (1994), a scholar of institutional economics, professes that societies which prove to be successful over a long term in terms of economic growth are those that developed “productive economic organizations” within the “institutional matrix” whose role is to support increased productivity. Tax systems are also part of this matrix and so they must evolve in order to promote productivity and thus growth.

Applying North’s ideas, other writers solidified the process of the effects of tax competition on growth, among them being Siebert and Koop (1990, 1993). They present the model in which countries compete with one another over mobile factors of production, using an immobile factor – legislation, including tax rules. Through trial-and-error processes, countries adopt the institutional arrangements that maximize their productivity and growth (Siebert and Koop, 1990). It is expected that countries’ institutional matrixes will become similar with time as follow-up effects and natural alignment will occur and such harmonization is seen as more beneficial than mandatory harmonization. Gatsios and Holmes (1998) provide a useful overview of the subject calling it regulatory competition, including the five benefits of natural coordination. First, given some general rules, countries are free to choose solutions best suited for their national circumstances and citizens; second, government is less burdened by the need to regulate and so governmental power is utilized in more productive areas; third, regulators must work to promote competitiveness of home production without the ability to interfere with imports; fourth, self-serving attitude of all regulators is restrained because countries must produce competitive national rules; and fifth, countries provide a trial-and-error arena in which various institutional arrangements can be tested.

While institutional economics scholars envisage tax competition as primarily beneficial (although they also note its disadvantages),

macroeconomists believe it to be less so. Tiebout (1956) was a pioneer of this school of thought, who constructed a theoretical model in which tax competition proved to be beneficial to the economy as it provided a fit between consumers, tax revenues and benefits. Following Tiebout and his followers, Brennan and Buchanan (1980) developed their model, which claimed that greater fiscal decentralization, as exemplified by the U.S., allows for competition among regions that restrains self-interested government officials from overtaxing and overspending in order to increase re-election chances. Brennan and Buchanan's (1980) call government overburdening country's citizens' with fiscal responsibilities a Leviathan. However, both theses have a small number of proponents, while the best known and most mathematically developed macroeconomic tax competition theory was presented by Zodrow and Mieszkowski (1986) and Zodrow (2003). They showed that tax competition, forcing countries to reduce tax rates to attract mobile factors of production, may lead to a lowering of tax revenues below a point necessary to provide the country's people with public goods. They coined the term race-to-the-bottom to signify the process of decreasing tax rates below the Pareto-optimal level.

Finally, since empirical testing of macroeconomic models proved to be very difficult due to the lack of suitable testing grounds, a new avenue of literature developed to contrast the position of Zodrow and Mieszkowski (1986) and Zodrow (2003) and support those of Brennan and Buchanan's (1980), Tiebout (1956) and their followers. Federalism-oriented scholars such as Feld, Kirchgassner, and Schaltegger (2005) used federalist countries, e.g. the United States and Switzerland, to show the benefits of tax competition among states within one country. Following the earlier arguments, they proclaimed the advantages of a check system on the fiscal powers of governments as well as trial-and-error method on implementing a tax system best suitable for countries' citizens, attracting foreign direct investment and economic growth.

In conclusion, theories explaining the linkage between tax competition, institutional systems and economic growth are vast and complex. They extend different economic schools of thought and apply various methodologies to arrive at their conclusions. The same holds for many empirical studies that have been conducted on the subject. Given that and space limitations, only some of them will be presented in this article.

### 3.2. Empirical surveys

The empirical work within the school of institutional economics in this area is nonexistent because of measurement difficulties. Two other streams – micro- and macroeconomics – provide results which will be the subject of this section.

European Union governmental institutions take an active role in trying to assess the macroeconomic impact of tax competition (or through its opposite side – tax harmonization) on economic growth. Among the studies subcontracted by the EU is one by Copenhagen Economics (2004). On a sample of twenty-five EU member countries, authors showed that harmonizing tax rates (at 27.2% for unweighted and at 32.6% for GDP-weighted average rate in 2004) and tax bases (at unweighted and GDP-weighted 2004 bases), in both cases will increase EU GDP by 0.8% and 0.4%, respectively, welfare will also increase by 0.2% and 0.1%, respectively, while total tax revenues will decline in the former case by 0.55% and rise in the latter case by less than 0.1%. However, individual country differences under this scenario are significant. Among individual countries GDP change varies between 3.7% and -2.5%, total tax revenues between 5.2% and -3.2%, whereas welfare between 0.9% and -0.2%. However, if harmonization only among some member countries is considered, that is among EU-15 or euro zone member countries the positive effects can only be maintained if GDP-weighted averages are considered. Next, Copenhagen Economics Group studied the effects of only tax base harmonization, again for unweighted and GDP-weighted averages. This time, GDP rose by 0.18% in the former case and by 0.35% in the latter case, welfare rose in both cases by less than 0.03%, and total tax revenues declined by -0.18% and -0.3%, respectively. Once again, individual countries' differences were large, for GDP change ranging from 3.5% to -3.2%, for welfare from 0.5% to -0.3% and for total tax revenues from almost 2.0% to slightly above -2.0%. Surprisingly, the study found that exchanging information within EU member states and among EU and tax havens results in insignificant gains or small losses, depending on a specific scenario.

Other econometric studies were more directly grounded in economic tax competition theories. Gramlich and Rubinfeld (1982) tested the Tiebout hypothesis on a sample of 2,001 households within the U.S. state of Michigan. The authors set forth two hypotheses: (1) citizens of similar tastes for public goods should be grouped together, so that variance within the community should be smaller than that between communities, and (2)

community should supply the level of public goods desired by its citizens. In fact, the first statement could not be refuted since 94% of surveyed respondents ranked at 1% level in the first test, 79% at the 5% level and 88% at the 1% level in the second test. Moreover, the second hypothesis could not be refuted as well, since in the Detroit area 2/3 of voters desired no change in the supply of public goods and the average of surveyed respondents wanted a change of less than 1% below the level offered at that time.

Still other researchers empirically tested the Leviathan hypothesis. Among them, Eberts and Gronberg (1988) found that a fragmentation of local and metropolitan general-purpose governments within the United States was significantly associated with a lower percentage of their population's income taxes, while single-purpose governments had a significant but opposite effect. Testing the same relationship at state level yielded no significant results. Zax (1989), who conducted his study based on a pool of 3000 U.S. counties, also arrived at a similar conclusion. He found that the greater share of county to local revenues (centralization measure) is associated with larger fiscal systems and that larger quantity of governments within a square mile (fragmentation measure) is related to smaller fiscal systems. While the above studies uphold the propositions of the theory proposed by Brennan and Buchanan (1980), empirical work by Forbes and Zampelli (1989) contradicts it. To test whether county taxes are lower in metropolitan areas with more competing jurisdictions, the authors used data for 345 counties in 157 metropolitan areas in the U.S. The dependent variable was a county government size and independent variables included population, income, area, race, education, poverty, measure of competition among counties, cost of governmental inputs and intergovernmental revenue. The results showed that increased competition among counties is associated with more taxes being paid by the residents of those counties (Forbes and Zampelli, 1989).

Other studies used the approach based on Zodrow and Mieszkowski (1986) to research the connection between tax competition and economic growth. Sørensen (2000, 2001a, 2001b), using a general equilibrium model, found that tax harmonization in EU15 members had very small gains in welfare of approximately 0.16%-0.35% of GDP. A similar result was obtained by Mendoza and Tesar (2005), who constructed a neoclassical general model of tax competition, confirmed that in competition between the United Kingdom and continental Europe (represented by France, Germany and Italy) the former has a welfare gain of 3.9% (labour tax adjustment) or 5.3% (consumption tax adjustment), while continental Europe suffers a loss

of 2.2% or 0.3%, respectively. However, the benefits of tax competition may seem low, especially when costs are considered. Parry (forthcoming) utilizing the Basic Tax Competition model, calculated that the costs of tax competition among EU15 members are large and approximate 0.15%-0.45% of GDP, depending on the chosen elasticity demand of capital with respect to tax rate.

Although an attempt was made to match the empirical research with their theoretical base, there is no clear boundary between econometric works. The federalism-oriented studies are even more difficult to place, since the above ones have also used the United States, a federal country, as a testing ground. Nevertheless, Feld and Reulier (2003) and Feld, Kirchgassner and Schaltegger (2005) provided a direct linkage to their federal outlook on issue at hand. First, Feld and Reulier (2003) using personal income tax rate data for cantons in Switzerland from 1984 to 1999, showed that lowering taxation of neighbouring cantons has a lowering effect on that of a canton's and lowering weighted average tax rate of all Swiss cantons has a similar impact. Second, a similar relationship was established by Feld, Kirchgassner and Schaltegger (2005) in their study of tax competition among Swiss cantons over the period 1980-1998, showing that increased tax competition between jurisdictions led to higher GDP growth.

## 4. MODEL'S ORIGINS

### 4.1. Solow's model

The model to be presented below is, to a degree, based on one presented by Solow (1956) which studied economic growth utilizing standard neoclassical production function with decreasing returns to capital. In the model, population growth and savings determine the steady state solution which is various for different countries. Saving is directly proportional to economic growth, while population growth is inversely proportional.

Beginning with a Cobb-Douglas production function, we have:

$$Y(t) = K(t)^\alpha [A(t)L(t)]^{1-\alpha} \quad (1)$$

$\alpha$  between  $[0, 1]$ ,

Y - output,

K - capital,

L - labour,

A - level of technology

$K$ ,  $L$ ,  $A$  are endogenous variables, so  $L$  grows at a rate  $L(t) = L(0)e^{nt}$  and  $A$  grows at a rate  $A(t) = A(0)e^{gt}$ . Thus,  $[A(t)L(t)]$  grows at a rate of  $n + g$ . Since  $g$  (depreciation of technology) is not country specific, it can be assumed to be constant across countries, but  $A(0)$  reflects other aspects such as country-specific endowments, i.e. institutions. Thus, we break up  $A(0)$  into “ $a$ ” (a constant) and “ $\varepsilon$ ” (a country-specific shock):  $A(0) = a + \varepsilon$ .

If  $k$  is defined as a stock of capital per effective unit of labour ( $k = K/AL$ ),  $y$  is a level of output per effective unit of labor ( $y = Y/AL$ ),  $s$  is the constant fraction of output invested, and if  $\delta$  is depreciation, then  $k$  changes as a result of:

$$k(t) = sy(t) - (n + g + \delta)k(t) = sk(t)^\alpha - (n + g + \delta)k(t). \quad (2)$$

The steady state solution is:

$$k^* = [s/(n + g + \delta)]^{1/(1-\alpha)} \text{ or } sk^{*\alpha} = (n + g + \delta)k^*. \quad (3)$$

One can also find a steady state income per capita, by taking natural logarithm of the above solution, so that

$$\ln[Y(t)/L(t)] = \ln A(0) + gt + [\alpha/(1-\alpha)]\ln(s) - [\alpha/(1-\alpha)]\ln(n + g + \delta). \quad (4)$$

Also,  $s$  and  $n$  are assumed to be independent of  $\varepsilon$ .

Moreover, Solow's (1956) model assumes that each factor is remunerated according to marginal product it produces, so that it predicts the sign and magnitude of relation between the factor and economic growth. We can also assume that each factor contributes about one third to the economic growth, which gives an elasticity of income per capita with respect to savings rate of about 0.5 and an elasticity of income per capita with respect to population growth of approximately -0.5.

#### 4.2. Mankiw, Romer and Weil's model

Given the above model, Mankiw, Romer and Weil (1992) augmented it to account for human resources (signified by  $H$ ). Production function then becomes:

$$Y(t) = K(t)^\alpha H(t)^\beta [A(t)L(t)]^{1-\alpha-\beta}. \quad (5)$$

If we assume  $s_k$  to be the fraction of income invested in physical capital,  $s_h$  to be the fraction invested in human capital,  $y = Y/AL$ ,  $k = K/AL$  and  $h = H/AL$ , then

$$k(t) = s_k y(t) - (n + g + \delta)k(t) \text{ and } h(t) = s_h y(t) - (n + g + \delta)h(t) \quad (6)$$

In this model, human capital is assumed to depreciate at the same rate as the physical capital and factors can be converted amongst each other without additional costs. From the Mankiw, Romer and Weil's (1992) connotation, we can derive steady state solutions as:

$$k^* = [(s_k^{1-\beta} s_h^\beta) / (n + g + \delta)]^{1/(1-\alpha-\beta)} \text{ and } h^* = [(s_k^\alpha s_h^{1-\alpha}) / (n + g + \delta)]^{1/(1-\alpha-\beta)} \quad (7)$$

and, when taking the natural logarithm, the function becomes:

$$\ln[Y(t)/L(t)] = \ln A(0) + gt - [(\alpha + \beta)/(1-\alpha-\beta)]\ln(n + g + \delta) + [\alpha/(1-\alpha-\beta)]\ln(s_k) + [\beta/(1-\alpha-\beta)]\ln(s_h) \quad (8)$$

The model discussed by Mankiw, Romer and Weil (1992) implies that:

- (1) there are no significant externalities to the accumulation of physical capital,
- (2) the accumulation of physical capital has larger and positive effect on income per capita than in Solow's (1956) model,
- (3) population growth has a larger and negative effect on income per capita than the Solow (1956) model predicts, and
- (4) countries similar in technologies, rates of accumulation and population growth should approach its steady states in income per capita more slowly than predicted by Solow's (1956) model.

Endogenous growth models such as the one presented above have been criticized, among others, by Barro (1989). The argument was based on that the model predicts "in the absence of shocks, poor and rich countries would tend to converge in terms of levels of per capita income" (Mankiw et al. 1992, p. 422). However, Mankiw, Romer and Weil (1992) argue that it is not so; rather income per capita in each country converges to that country's steady state value (p. 422). On the other hand, in the endogenous growth models no steady state level of income is attained. The differences between countries continue even if countries have equal rates of determinants. For multi-sector

endogenous growth models, convergence might occur when the initial income of the country is correlated with the degree of imbalance between the sectors.

## 5. MODEL'S SPECIFICATION AND DATA

### 5.1. Equation

Feld, Kirchgassner and Schaltegger (2005) model the real gross domestic product (GDP) denoted by  $q_{it}$  of EU member country (i) at time (t) as a function of their initial endowments with labour ( $l_{it}$ ), human capital ( $h_{it}$ ) and plant and equipment signifying physical capital ( $k_{it}$ ). Then, the Cobb Douglas production function is as follows:

$$(9) \quad q_{it} = l_{it}^{\beta_1} h_{it}^{\beta_2} k_{it}^{\beta_3} e^{\beta_0 d_{it} + \varepsilon_{it}}$$

$\varepsilon_{it} \sim \text{LN}(0, \sigma^2)$ ,  
 $i = 1, 2, 3, \dots, 20$ ,  
 $t = 1990 \dots 2005$

$\varepsilon_{it} \sim \text{LN}(0, \sigma^2)$  denotes the technological disturbance which is independent of other terms and follows logarithmic normal distribution.  $\beta_j = 1, 2, 3$  are output elasticities with respect to factors of production  $l_{it}$ ,  $h_{it}$  and  $k_{it}$ . Institutions are part of technology variable and are placed in the error term ( $\varepsilon_{it}$ ) which will be modified at a later point. To simplify the equation, take the natural logarithm of both sides, which gives us the following:

$$(10) \quad \ln q_{it} = \beta_0 d_{it} + \beta_1 \ln l_{it} + \beta_2 \ln h_{it} + \beta_3 \ln k_{it} + \beta_4 \ln v_{it} + \varepsilon_{it}$$

- $\beta_0$  through  $\beta_4$  are parameters of interest
- $\varepsilon_{it}$  is the error term
- $d_{it}$  is measured by the difference between country i's capital tax rate and the average of neighboring countries capital tax rates
- $l_{it}$  is measured by the number of employees in a country
- $h_{it}$  is measured by country's education spending per capita
- $k_{it}$  is country's capital investment
- $v_{it}$  is a vector of control variables, including country's population

The greater level of tax competition is expected to have a positive influence on economic growth.

A significant modification of model by Feld, Kirchgassner and Schaltegger (2005) is an addition of variable  $a_{it}$  to signify technology and  $i_{it}$  to represent institutions. Then the equation to be estimated becomes:

$$\ln q_{it} = \beta_0 d_{it} + \beta_1 \ln l_{it} + \beta_2 \ln h_{it} + \beta_3 \ln k_{it} + \beta_4 \ln v_{it} + \beta_5 a_{it} + \beta_6 i_{it} + \varepsilon_{it} \quad (11)$$

Further, since technology is a factor that intensifies the efficiency of labour, following the methodology of Barro (1997) one can add  $a_{it}$  as a factor of  $l_{it}$ . This is appropriate because one can say that as new innovations are used by labour in the production process, the work performed by employees becomes more efficient. The equation now becomes

$$\ln q_{it} = \beta_0 d_{it} + \beta_1 \ln l_{it} + \beta_1 \ln (l_{it} * a_{it}) + \beta_2 \ln h_{it} + \beta_3 \ln k_{it} + \beta_4 \ln v_{it} + \beta_6 i_{it} + \varepsilon_{it} \quad (12)$$

The equation will be estimated using the OLS (ordinary least squares) technique.

## 5.2. Data

The data for econometric modeling were obtained from the Eurostat database and apply to years 1998-2004. Not all EU member countries are incorporated into the model also due to the lack of adequate data. Countries included in the sample are: Belgium, the Czech Republic, Denmark, Germany, Spain, France, Ireland, Italy, Latvia, Lithuania, the Netherlands, Austria, Poland, Portugal, Slovakia, Finland, Sweden, and United Kingdom.

Given the  $qp$  (GDP in millions of euro (from 1.1.1999) or millions of ECU (up to 31.12.1998) divided by population) as an independent variable, the following dependent macroeconomic variables will be tested:

- $d\_capital$  – difference between country  $i$ 's capital tax rate and the average of neighbouring countries capital tax rates;
- $d\_labour$  – difference between country  $i$ 's labour tax rate and the average of neighbouring countries labour tax rates;
- $l$  – total employment of persons above the age of 15 (in thousands);
- $h$  – total number of students;
- $h\_grad$  – total number of post-secondary school graduates;
- $k$  – fixed capital formation in millions of euro (from 1.1.1999)/millions of ECU (up to 31.12.1998)

- a – total intramural research and development in millions of euro (from 1.1.1999) or millions of ECU (up to 31.12.1998);
  - p – control variable: population;
- where i denotes the EU member country.

The above variables are included based on theoretical models of tax competition as well as macroeconomic theories. Tax competition measures of  $d_{\text{capital}}$  and  $d_{\text{labour}}$  are calculated following Feld, Kirchgassner and Schaltegger (2005). The variables signifying total employment (l), education (h and  $h_{\text{grad}}$ ), capital (k), research and development (a) and population (p) are chosen in such a way to produce the most accurate results given the inaccessibility to more exact data. It is expected that GDP per capita should increase in the presence of tax competition, increased employment, education, capital investment, and research and development.

Institutional characteristics of an economy are very difficult to quantify. Only recently has institutional data begun to be collected by data collection agencies. Thus, even when available, the time periods are quite short. While the best institutional tax measures would be those assessing the linkage between tax system characteristics and the business environment, in this work the author was forced, due to data constraints, to use the alternative. Therefore, the measures which characterize the tax systems of a country while impacting business operations were utilized. Using the work of institutional economists as a guideline, the following institutional variables were chosen:

- $\text{tax\_inc}$  – taxes on income or profits of corporations including holding gains of country i's in millions of euro (from 1.1.1999) or millions of ECU (up to 31.12.1998);
- $\text{rec}$  – total tax receipts of country i's in millions of euro (from 1.1.1999) or millions of ECU (up to 31.12.1998);
- $\text{rec\_un}$  – total unlikely collectable tax receipts of country i's in millions of euro (from 1.1.1999) or millions of ECU (up to 31.12.1998);
- $\text{contr\_er}$  – total labour contributions by employer in country i's in millions of euro (from 1.1.1999) or millions of ECU (up to 31.12.1998);
- $\text{contr\_es}$  - total labour contributions by employees in country i's in in millions of euro (from 1.1.1999) or millions of ECU (up to 31.12.1998).

All are expected to negatively impact the GDP per capita of a country, since, in short, the more monies are paid in taxes by businesses the less can be used for reinvestment and so for the companies' development.

## 6. RESULTS

The estimation results for equation (12) are presented in Table 4. In estimating, fixed effects were assumed. The within  $R^2$  is high at 92.83%, which means that chosen dependent variables explain most of the variation within each member country. Macroeconomic variables when tested had the expected signs. All variables proved to be significant contributors to GDP per capita, except for tax competition measure on labour. This might be because institutional variables (*contr\_er* and *contr\_es*) already measure the impact of social security contributions by employers and employees to economic growth. The *d\_labour* variable is based on *contr\_er* and *contr\_es* measures that in our equation (12) proved to have a significant impact on economic growth.

While the relative strength of each variable should be observed, the specific magnitude should not be dwelt on. Tax competition measure is relatively weak, while institutional measures are relatively strong. As corporate income tax competition increases by 1% point, GDP per capita increases by only 0.3%. The predicted positive sign is correct, as increased tax competition increases economic growth. For institutional measures, as employer and employee contributions rise by 1% point, GDP per capita increases by 8% and 9%, respectively. Although we have expected a negative sign of the relationship, it is positive. One possible explanation might be that GDP per capita increases when the structure of socially provided services is sound and stable, and benefits needed to attract and safeguard a skilled and knowledgeable workforce are provided. The same equation was tested using fixed and random methods. The Hausman test showed that the fixed effects model is a better predictor of the tested relationships.

Table 4  
Estimation results

<b>ln_qp</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t statistic</b>	<b>P&gt; t </b>
d_capital	.0031516	.0013731	2.30**	0.024
d_labour	.0038813	.0041508	0.94	0.353
ln_la	.1773757	.0579093	3.06***	0.003
ln_h_grad	.2336374	.0414687	5.63***	0.000
ln_k	.2269642	.0695377	3.26***	0.002
ln_contr_er	.0809703	.0452306	1.79*	0.077
ln_contr_es	.0926049	.02678	3.46***	0.001
cons	-13.77159	.4487645	-30.69	0.000
F(7,80)		=	148.03	
corr(u_i, Xb)		=	-0.8339	
Prob > F		=	0.0000	
rho 0.99906672 (fraction of variance due to u_i)				
*** significance at 1% level, ** at 5% level, * at 10% level, respectively				

Source: author's own

Other equations were also tested, however, their results are not included here to preserve space. The inclusion of additional tax competition measures diffuses the impact of each separately and they prove to be jointly, but not individually, significant. While in general, corporate tax competition and elements of the labour tax system have a meaningful impact on economic growth, when conducting analyses similar to one above, one should be cautious about overestimation and the variety of ways in which results might be interpreted as taxes impact the economy in many different ways.

Tax competition and economic growth interplay is a natural extension of the linkage between taxation and growth extensively tested in recent econometric literature. The former research development is quite new and no other models, besides Feld, Kirchgassner and Schaltegger (2005), exist. However, there are alternative measures of capturing tax competition variable such as computing the difference between the region and particular EU members or the standard deviation between the country and its neighbours. Once again, the author is not familiar with such variables used in the empirical studies to examine the relationship between taxation and economic growth.

## 7. CONCLUSION

This article aims at assessing the impact of corporate taxes and social security contributions as well as the institutional structure of selected European Union members on the economic growth of these countries. Over the last fifty years a wealth of theories developed – Tiebout (1956) hypothesis, Zodrow and Mieszkowski (1986) model, federal and institutional streams – that tried to explain these complex relationships. While some saw it as positive and others as negative, extensive empirical testing, of which only a limited number were presented here, was performed to approve or disprove them. Based on these theoretical and practical suggestions, an endogenous growth model was used to test the link between tax institutions, tax competition and economic growth. The results show that there is a positive connection between those variables, although the strength cannot be assessed. Future work to extend the time period under study and include other institutional variables will be undertaken soon.

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