**MYKOLAS ROMERIS UNIVERSITY**

**BUSINESS AND MEDIA SCHOOL (BMS)**

**AKVILĖ KNIUKŠTAITĖ**

# IMPACT OF PROGRESSIVE PERSONAL INCOME TAX ON EFFICIENCY OF FISCAL, REDISTRIBUTIVE, REGULATING TAX FUNCTIONS IN THE EUROPEAN UNION

**A master`s thesis**

**Supervisor**

**assoc.prof.dr. Marius Lanskoronskis**

**VILNIUS, 2016**

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**A master`s thesis on financial markets 621L10009**

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# INTRODUCTION

Tax is a main income source for the most of countries. Tax burden, depending on a country, is spread within various different forms of tax. Most of tax burden usually needs to be covered by natural persons throughout direct or indirect taxation. Personal income tax is the most significant in comparison to rest of tax and reaches around 9 % of total GDP in EU every year. Based on this index, every country has a main objective – to ensure effective personal income tax collection system, herewith acceptable for society. There are 3 most common types of tax collection systems : progressive tax, regressive tax and proportional tax. Most of EU members use progressive taxation, rest (including Lithuania) - use proportional taxation combined with some pieces of the system, that enables progressiveness. Regressive taxation is not applied in EU member states, or has only partial implications of it on some tax, therefore in this context it becomes significantly important to comprehend progressive taxation, its effectiveness and impact on both country and its people level.

As any other taxation, progressive tax system has its objections that relates to budget formulation, income distribution, assurance of government functions implementation, reduction of negative economic aspects (e.g. emigration), economic growth of a country. In others words, this is to ensure fiscal, redistributive, regulatory tax functions fulfillment. There are many discussions and concerns regarding effusiveness of functions mentioned before in context of different tax systems possible. It is being considered at what level progressiveness is the most beneficial to whole society and is least harmful to different society groups. For this reason, there are various indexes used to compare different countries and influence of its tax systems in order to indicate how taxation could be developed and to meet demand of tax system participants.

Topic regarding possibilities of transferring from proportional to progressive tax system are becoming more often in recent discussions in Lithuania. To support this opinion, it is being stated that progressive tax system would ensure higher incomes to country`s budget, reduce social inequality, however it is not clear, how it would really affect implementation of tax function or significant economic and social dimensions of the country. Moreover, it is unclear how new tax system and its aftereffects would reflect to country`s political and economic fluctuations.

Key **problem** in this thesis is raised to evaluate, how progressive tax system impacts efficiency of fiscal, redistributive and regulatory tax functions?

Below hypothesis have been raised in this work:

H1: Countries that implement progressive tax system, accomplish more effective fiscal tax function, than countries applying proportional tax system.

H2: Progressive tax system is more favorable to ensure efficient redistributive tax function compared to proportional tax system.

H3: In comparison to proportional tax system, progressive tax system enables more successful implementation of regulatory tax function.

**Main object of this thesis** – analyze and compare personal income tax systems in EU and evaluate its impact to fiscal, redistributive, regulatory tax functions.

Below **objectives** have been raised:

1. Literature review and analysis on progressive tax system, evaluating positive and negative aspects of the system;
2. Analysis of measures that are used evaluating progressive tax system;
3. Analysis of personal income tax systems and its variation in Belgium, France, Bulgaria, Denmark, Lithuania;
4. Evaluation of progressive tax system`s impact and its significance to fiscal, redistributive, regulatory tax functions in selected countries and in scale of EU.

This thesis is supported using articles, publications, public researches of Lithuanian and foreign authors. Statistics, such as (personal income tax, tax rates, GDP and etc.) have been used for evaluation of progressive tax system`s impact. First part of theses presents origin and conception of progressive tax, second part reviews tax systems within EU and presents methodology of tax functions` analysis. Third part of thesis analyses personal income tax systems, implemented reforms, statistical indictors of selected EU member states. Fourth part of thesis evaluates impact of progressive personal income tax on fiscal, redistributive, regulating tax functions within selected countries and final part of thesis evaluates this impact within EU level. Based on results of analysis, conclusions and recommendations are provided at the end of this thesis.

# 1. CONCEPTION OF PROGRESSIVE TAX

## 1.1. Origin and conception of progressive tax

The origin of tax has been linked to primary civilizations in relation to paying tributes to land lords or sacriface to Gods. The Bible is one of primary sources describing tax that distinguishes 4 types of it: income, property, capitation and special tax. In 17th-13th centuries B.C. Egyptians had been already forced to pay 20% income tax of collected harvest (M. L. Jose, 1998). Collected money was used to finance expenses of war, celebrations, personal expenditures, therefore soon taxation in various levels was applied to other cities, countries in order to collect as much income as possible.

Existence of progressive tax dates back to the same period as proportional tax - Ancient Greece to be one of the examples of it. Even though, concepts of tax system were not similar to current systems, Plato, Socrates, Solon had been already discussing about value of the money, value changes when amount of money increases and income distribution within country. It is worth to mention, that in Athens it was even a civil honor to pay tax, that could have been influenced by philosophers 'teaching on morality and ethics. In his work „Politics" Aristotle states that increasing incomes decrease its benefit and that loss of increased income, would not cause additional negative consequences. On a contrary, he states that when incomes are increasing, negative effect of increasing tax per person is reducing, therefore Aristotle was supporting concept of progressive tax.

In 4th-3rd centuries B.C. Plato (teacher of Aristotle) was observing personal wealth either. He stated, that under ideal circumstances, wealth of each person, should not be higher than four times of what poorest person in that territory owns. In this case, each person would get own land-plot that generates incomes. Once total budget would exceed primary value of land four times, surplus would be given away to government. Obeying of rules would cause loss of the land-plot. This scheme endeavors avoidance of wealth inequalities and conflicts (R. A. Westin, 2014).

At the Age of Enlightenment, there were many discussions regarding marginal utility of income. J. Bentham observations state that from legal side perspective, person that earns higher incomes, should also be happier than other person. However, level of happiness could not increase proportionally to increased amount of incomes. There is a doubt that once incomes would increase ten times, that the level of happiness and satisfaction would increase two times at least (Bentham J. 1843). This position highlights advantage of progressive tax as a tool to ensure public welfare: persons that earn more and do not receive apparent benefit

from surplus - pay higher tax, whereas persons with lower income – pay less tax, save more, have more benefits and higher satisfaction.

It can be said that taxation in ancient Athens is one of first systems that applied progressive tax. People there were divided into four groups (based on their property) and had to pay approximate 10% of income tax. Tax rate was equal to everyone, however progressiveness was applied based on level of income. The richest group had tax applied to all of the income, second group had tax applied on 5/6 of their income, third group – 5/9 only. Fourth group in this system with lowest income and poor financial opportunities, had a dispensation for this tax. Yet, government revenue was mostly dependent on tax paid by the rich people (Seligman, 1894). Example of such additional tax that brought highest revenues to budget of Athens were liturgy fee, which goal was to oblige rich people performs their civic duty, therefore pay for all public services. It is worth to mention that this system allowed transferring duty of paying liturgy fee to other, even richer people. For example, if person believes that other person receives higher income, he had a right to assign it. However, there was also a law, which allowed to avoid assignation in cases when property value was believed to be equal or lower than person`s who initiated transfer in a first place. In these cases, two options used to be suggested: 1. to swap property (duty to pay fee is applied to transfer initiator), 2. bring the case to court for further investigation. This system and other tax for funding wars, religion, government expenses, was mostly based on property but not income value. Even though administration of property tax is challenging, due to effective tax collection schemes, strict fines, civil responsibility, it was managed remarkably. Moreover, rules applied in Athens, reveals utilization of progressive tax and benefit to government that receives most of income from tax applied to the richest people (R. A. Westin, 2014).

Many years after antiquity, tax collection subject became wider and gained significant meaning in every country`s existence: different types of tax were increasing, calculation and collection systems were changing. The very first personal income tax in continental Europe were introduced within Renaissance in Italy, later on in 17th-18th centuries in France and Holland (Seligman, 1894). The beginning of progressive tax dates back to ending of 18th century in Great Britain. While preparing for Napoleonic Wars in 1798-1799, government had decided to apply personal income tax. There were 3 groups of taxpayer’s: persons that earn less than 60 pounds were given dispensation to pay tax, persons were paying 0, 0083% of their income if they earned 60-200 pounds and then 10% of their income if they earned more than 200 pounds. System was valid within period of war; otherwise this duty was not applicable (R. A. Westin, 2014).

Public approach towards tax system started to change significantly since the second half of the 19th century. Tax system was realized to be as powerful economical mechanism of the governance, and one of key sources that funds total budget, instead of previous view to the system as remuneration to country for social, political and economic welfare. Tax systems in line with personal income tax were becoming more complex. Every country started building its own pieces of legislation, regulations, agreements, tax calculation and application procedures, cross-border agreements regarding double taxation or other tax obligations.

Long history of taxation, enables countries to have comprehensive evaluation of the system, public reactions to it under different economic and social events. This type of analysis is significant while choosing the most appropriate personal income tax system and introducing it to public. Progressive tax exists when taxpayer's are divided into groups based on level of incomes thei receive and if income index is increasing each group is then paying higher tax rate. Depending on a system, there could be various tax rates within one system with very low differences between it. In this case insignificant change of personal income value, immediately determines increase or decrease of tax rate. Other opion could be, that system has a few limits of taxe rate change – there are large ranges where tax rate remains stable. In this case, approaching margin of higher tax rate, raises tax evasion risk as insignificant change of personal income value may cause higher tax rate application, therefore net income would be lower against prior increased gross income amount.

Progressiveness can be divided into two types: ordinary and complex. First type applies equal tax on full income amount while income increases and rate changes. In complex type, when income exceeds margin and tax rate increases, higher income tax rate is applied only to amount thats is above margin. This case mitigates tax increase, when taxable income is growing (Seidl, 1970).

Implementation of progressiveness is possible while reducing taxable income. For example, when 30% tax rate is applied to all people in country, and 200 EUR is set as non-taxable amount, persons that receive 1000 EUR would need to pay 240 EUR (24% of personal income), persons that receive 2000 EUR would need to pay 540 EUR (27% of personal income). System based on this principle means those persons who receive higher personal income, gives away higher share of their earnings, as with each additional euro earned, non-taxable amount value is decreasing.

Not only tax rates differs systems but also the selection of margins that once being approached tax obligation occurs. In some countries tax obligation starts from first euro earned, whereas other countries set specific limit for obligation to begin. In order to make the system more progressive, primary level of taxation can be achieved by using non-taxable

income rate calculations. In this case certain formula is being created and used to calculate non-taxable amount of personal income. Formula is constructed in a way that when personal income is increasing, non-taxable amount is decreasing and once specific margin would be reached, it would indicate that level of personal income is high enough, therefore non-taxable amount does not apply anymore. There are two main advantages for this type of system:

- ✓ Persons that receive higher income, pay complete amount of taxes, therefore more income is received to country`s budget.
- ✓ Persons that receive lover income, have dispensation from income tax application until specific margin is reached, herewith standard of living increases for them.

This type of progressiveness covers relatively small part of the whole system and has limited impact on tax collection and reduction of social inequality (Bikas E., 2014). However, combination of various tax calculation methods, criteria's for taxable amounts, creates an opportunity fully evaluate and take into consideration economic and social status of society, its ability to pay mandatory tax, as well as to reduce income inequality in a country.

### 1.2. The purpose of taxation

At all times, the main purpose of taxation that is specified by both: scientists and ordinary people are to secure sufficient level of income for the implementation of the most important functions of government. Adam Smith discussed this topic regarding purpose of taxation in his works either. In a context of taxation, A. Smith firstly analyses challenges and objectives countries` interfere, such as country's defense, maintenance of effective legal system, insurance of minimal level of education and other public services that were non-profit and were seeking highest benefits for people. These expenses need to be funded by collected tax, however collected amount needs to be exact to strictly necessary funding for the implementation of country`s operations. Besides, A. Smith states, that taxation needs to stay correct, proportional to people`s ability to pay tax and collected handily. Moreover, tax amount should meet people`s satisfaction about the services for which they have paid to the government. On a contrary, people should feel civic duty to pay for what they are getting form their country (Chittenden, 2008). In this case, even the poorest people should be accounted as taxpayer`s, as they are competent members of society and are using common services provided, however that would might cause higher expenses to collect and document

that type of tax and would not redeem administrative costs. For this reason, it is obvious that tax system needs be analyzed in detail and beneficial to all participants of the system.

In recent times, taxation is no more aligned to direct benefit to taxpayer`s in economic theory. The role of tax system framework was extended in relation to country and its people. Additionally to implementation of public sector functions, new aspects of public debt funding, solving and prevention of ecological problems, reduction of unemployment, ensuring micro and macro stability level in a country added. Example of tax system that is based on objectives implementation is tax system of Scotland (Principles for a Modern and Efficient Tax System Principles, 2013). There are 5 objectives of tax system identified: government funding, equality and income distribution, ensuring macro-economic stability, influencing public behavior changes, assurance of growth and competitiveness. Once objectives are established, guiding principles are created and specific methods (tax type selection) applied for accomplishment.

There are 3 main objectives which can be identified, while analyzing reasons for tax collection application: implementation of fiscal, redistributive (or social) and regulatory functions. Fiscal function reveals that incomes from tax provides highest funding to country`s budget. Without it, insurance of government and its institutions activity would be challenging. Second function seeks to redistribute collected funds among individuals, entities, and certain economic or other activities. Most common forms of this redistribution are: subsidies, charity, social benefits, however concrete system and rules are implemented differently in each country. Regulatory function aims to influence microeconomic and macroeconomic processes, such as: unemployment, consumption or gross domestic product variations.

Objectives of progressive tax system match general objectives of tax, yet it has own specific objectives, that would be hardly implemented while applying proportional or regressive tax systems. David A. Hartman (2002), highlights 3 main social objectives raised for progressive tax system. First objective seeks to distribute tax burden from poor to rich people. Second objective is country`s capacity to distribute revenues of society members. Third objective strives to reduce economic and political power of wealthy people these objectives are oriented to ensure social, economic equality and justice. However, determination of equality level and efficiency for public development is a moot question. There are many discussions among scientists, taxpayers regarding relevance of progressive tax system to general tax collection process, its effect to society and common welfare. Yet, as theoretical objective of progressive tax system can be named its aspiration to reduce existing

isolation among people that receive different level of income, while transferring tax burden to wealthier members of society herewith increasing revenue for government.

### 1.3. Advantages and disadvantages of progressive tax

Topic regarding taxation has been under many discussions, arguments for a very long period of time. Most of the countries would not be able to operate and exist if tax collection would be insufficient. Further, in order to ensure its objectives (social stability, national security), countries seek to collect more revenue from tax. Controversially, members of society are eager to give away less money, however seeking social security and accommodation from the country at the same time.

While analyzing discussions of scientist and economists, two groups: proponents and opponents of progressive tax system can be identified. Supporters as Miculescu, Grui, Manovskii, highlight advantages of this tax system, others, as Blum, Kalven, Sabirianova, Hartman criticize it. Based on analysis, below groups of positive aspects can be identified:

- ✓ Benefit to taxpayers;
- ✓ Benefit to tax-collectors;
- ✓ Benefit to whole country and its people.

This spread could be extended by distinguishing taxpayers group to upper class, middle class and working class, because when progressiveness is increasing, tax burden is adapted from one group to another, therefore common benefit directly or indirectly is spread within society and increases common welfare of the country.

Kip Hagopian (2011) excludes three main groups of advantages of progressive tax system. First group relates to economic efficiency motives: K.Hagopian states that, progressive tax application increases employee productivity that encourages overall efficiency and revenue to increase. Second group relates to fairness that is being stimulated by progressiveness. It highlights benefit principle, which means that tax is being paid for public services, protection provided by a country. People, who earn more, have risk to lose more; therefore higher tax should be applied to them. Moreover, this group highlights sacrificial theory and marginal utility of money, which states that when revenue is increasing and its granted utility is decreasing, tax rate should increase in order to reduce burden for poor people and money that brings higher benefit to them would be used for other purposes. Third group emphasizes person's ability to pay tax, which means that wealthier people have an opportunity to cover higher amount of tax, therefore it is correct thing to do. Furthermore, K.Hagopian states that, progressive tax application reduces financial inequality.

Positive impact of progressive tax to employee productivity and welfare of society is analyzed by Iourii Manovskii (2002) as well. He states that progressive tax system obliges people to give away part of income in short-term; however at the same time system encourages to reach higher goals that governs to better financial situation in long-term. In his research I. Manovskii was comparing differences when progressive tax systems are changed to proportional. Results of research revealed that in this case: output, productivity and welfare reduced, herewith inequality of net income and wages increased. Reasons for this outcome are: reduced labor mobility that leads to decrease of productiveness which is due to low incentive to reach out for better results. Moreover, progressiveness encourages mobility within both: low-level and high-level income receivers because changing to new position that pay less and has better future perspectives leads to lower tax rate being applied, whereas proportional tax system could hold from this risky decision.

It is certain, that when establishing tax system and tax rate, countries are seeking some benefits for it. Marius-Nicolae Miculescu and Sergiu-Dorin Grui (2012) states that progressive rates ensure effective tax collection from people that are capable to pay it. At the same time, level of poverty is reduced, as people who earn less get dispensation or low tax rates applied and can have better life quality. Furthermore, higher tax application on wealthier people who are more enterprising and generate increasing income, might ensure more stable income flow, expense coverage for public sector maintenance (The Progressive Income Tax, 2012). It is worth to mention, that progressive system enables low and medium income receivers to save (as less it spends on tax) and to spend savings on goods and services, herewith increasing domestic consumption and stimulating economic growth of a country.

C. Checherita-Westphal, M. Rieth and M. Attinasi (2011) have analysed ratio between progressive personal income tax and automatic stabilizers. Operation of automatic stabilizers with no involvement of government affects economic cycle and reduces amplitude fluctuations (if government does not operate contrary to the system). In theory, when economic situation is improving, government revenue increases as well, therefore in this case, increase of people`s salary causes increase of tax rates and higher income to country` budget. This can be also illustrated by review of country`s examples which states that while another factors are staying unchanged, progressive tax system enables stronger effect of automatic stabilizers and leads to better country's economic security in periods of recession.

Summing up advantages of progressive tax features, states that if system performs effectively, it ensures less separation among society members reduces level of poverty, stimulates consumption of middle-class and productivity. From government perspective, this system enables effective collection of higher tax amounts. Moreover, progressive tax

positively impacts operation of automatic stabilizers, therefore stimulates stable growth of country`s economy.

To ensure comprehensive analysis of progressive tax, it is essential to revise negative aspects of this system:

1. Expensive and complex administration;
2. Increase of social injustice, permanent attitude of problematic social groups towards work;
3. Increasing risk of emigration and tax evasion;
4. Inefficient reduction of income inequality.

Despite obvious defects of this type of taxation, disadvantages of the system can be discovered while analyzing its benefits. If we return to idea stated by K. Hegelian, theory about higher country`s protection to taxpayer`s that give away more is not fully affirmative or has neither positive, nor negative effect to society. Firstly, all people should be equal and have legal right to country`s protection. Moreover, wealthier people usually cover their health and wealth insurance costs; therefore country does not spend more money on them. On a contrary, funds are being saved in this case.

There are some concerns regarding sacrificial theory either. Its statement that income increase, reduces marginal utility of money, therefore funds should be distributed to low income receivers is quite questionable, as marginal utility curve is completely different for each individual. People change their habits, its significance and volume, based on circumstances that they experience. It is important to notice that there are some people who work because of payment they receive, which enables to fulfill own needs, but these people do not experience any satisfaction from just work itself. For this reason, distribution of funding from hard workers, to the ones that avoid hard work is in in contradiction with fairness. It can be supported by Kalven and Blum observations, which states that it is not possible to distribute welfare equally, and that progressive taxation is beneficial to one part society and is harmful to other. Moreover, concerns regarding effective usage of collected funds, its distribution among poor people to develop welfare and own expenses of government funding are raised (Rothbard M. N.).

Bernard Salanie (2011) observes that under progressive tax system, working hours may reduce due to substitute effect, as leisure time becomes more attractive than work. Working hours may increase as lower income for same period of time, will stimulate person to compensate the loss. R. A. Westin believes, that in order to maintain or increase welfare, people will just simply work more and will not experience any harm due to progressiveness.

Research of Michiel Evers, Ruud de Mooij and Daniel van Vuuren (2008) proves that increase or decrease of working hours is not significant while evaluating progressive tax system. Their study on wage elasticity of labor supply, revealed that when hourly rate change reaches 1 percent, change of man working hours is 0,07 percent, change of women working hours is 0,34 percent. This indicates that labor supply is inelastic to wage. Alvaredo (2013) states that in context of high income receivers, increasing tax rate and eager to compensate it with additional income, not necessarily implies increase of working hours and labor productivity, as it could be strong negotiation skills of those employees. In this case, income increase identifies fund distribution among employees (not economic growth of a country) and it may affect low income receivers negatively. Furthermore, if we anise wider aspects, progressive tax system enables development of human capital, therefore education level becomes insignificant and level of qualified personnel is decreasing (McBride, 2012). All of above illustrates that progressive tax system may cause dissension among employees due to difference of working hours and wages, at the same time, negatively affecting company`s results and personal welfare.

Progressive tax systems have many different rates, levels of income, complex accounting, therefore it is expensive and difficult for companies and country itself to administer it. Investment to ensure effective implementation of this system is increases, therefore higher rates applied to wealthier people, will not necessarily determine increase of state revenue or reduction of budget deficit. Moreover, N. Miculescu (2012) states, that progressive taxation may reduce investments to consumer goods and enhance investments to equities. Furthermore, application of Laffer curve reveals that the immoderate tax rate on incomes of wealthier people, may raise a risk for tax evasion, black economy end even increased emigration, as it would mostly be highly qualified employees, who are more mobile and able to find new work in foreign country. As tax evasion is possible by becoming citizen of another country, or simply by opening bank account overseas, where tax system is more favorable (Godar, 2014), it causes huge loss for country`s budget. Furthermore, people avoid tax applications by increasing disposable income, herewith disposable income of conscientious tax-payers is reducing and net income inequality in a country is increasing (Sabirianova, 2012).

David A. Hartman challenges one of progressive tax objectives – distribution of income in a country, that should lead to social equalty and wellfare. His reasearch, that was conducted in period of 1957-1997 analysed 10 % of highest incomes receiving people and rest 90% of people of United States, their tax duties and revenue after application of income tax. Results revealed that when tax rate for wealthier people is increasing and tax burden is

increasing either, revenue after tax applications is reducing for rest of the people as well. This case implies opposite effect of progressive tax system than expected, as it does not generate expected benefits from income distribution process. Morover, it reaveals system inefficiency and possible causes of reducing consumption.

Final remark regarding negative aspect of progressive tax system is that it causes general social inequality, by dividing people to different groups and applying rates, based on income index only. No consideration of education, efforts, reduces signifance of career or education and leads to application of highest tax burden to most efficiant members of society whose added value is usually highest.

### 1.4. Indicators of income distribution evaluation

Application of various indicators reveals levels of progressiveness in each country. Moreover it enables to evaluate if progressive tax system is effective and reducing financial inequality. These indicators do not reflect system comprehensively and it is not always possible to compare it, due to different calculation techniques, however, various studies conducted try to evaluate and identify proper guidelines for tax systems` evaluation.

Denvil Duncan highlights three groups of existing measures. First group is related to identification of highest personal income rate within country. Second group is based on inequality measurement. Third group is based on effective progressiveness measurement. Indicator from first group is commonly used in primary studies as it enables to compare different countries. However, D. Duncan (2014) states that before using this indicator, it is a must to evaluate scope of tax application and whole structure of the system, as progressive and proportional systems are too different, its comparison would be inaccurate, because the tax rate is applied to diverse part of society and determines different percentage of collected income.

As mentioned before, second group is based on inequality measurement. One of the most common indicators in this group is The Gini coefficient (sometimes expressed as a Gini ratio or a normalized Gini index) - measure of statistical dispersion, that seeks to represent the income distribution of a country's residents, and is the most commonly used measure of inequality. It is based on statistics of consumption and household income. Gini coefficient is calculated from gross income and disposable income, therefore some inaccuracy may apply. Gross income is total personal income (salary, individual and property income), before accounting for taxes or deductions. Disposable income - income remaining after application of taxes. A Gini coefficient of zero expresses perfect equality, where all values (for example,

where everyone has the same income) are the same. A Gini coefficient of 1 (or 100%) presents maximal inequality among values, for example: for a large number of people where only one person has all the income and/or consumption, and all others have none.

Further possible indicator that is possible to use is - the Lorenz curve. This curve (developed by Max O. Lorenz in 1905) represents distribution of income or of wealth. Moreover this curve is also used to represent income spread, where it shows for the bottom x% of households, what percentage (y %) of the total income they have. Furthermore, similar to the Gini coefficient, there is index called Suits, which is calculated by comparing the area under the Lorenz curve to the area under a proportional line. For a progressive tax - Suits index is positive. A proportional tax - Suits index of zero, and a regressive tax - has a negative Suits index. Last index, that is worth to mention, is Kakwani index. This index measures progressivity of a social intervention, and is used by social scientists, statisticians, and economists. The Kakwani index applies Gini framework to measure progressivity of social intervention. Larger index, identifies social intervention as more progressive. In respect of tax, this index is capable to measure progressivity of tax systems. Kakwani index would be equal to Gini concentration index for collected taxes (Oxford reference, 2016)

It is important to mention that all detailed measurements, requires data about income inequality before and after application of tax. Since collection of this data is impossible or its comparison is hardly applicable, calculations become complex and not fully reliable. Moreover, it may be caused due to asynchronous data on income inequality that has direct impact on calculations of progressive tax system influence to income inequality.

Last group of effective progressive measurements seeks to evaluate changes of tax rates at different points of income distribution (Musgrave and Thin, 1948). Even though, these calculations do not use data on income inequality after tax application, it requires data on gross income distribution and causes challenges regarding information collection, its comparison, in order to provide comprehensive results analysis on progressiveness. In context of income distribution and structural changes within it, there are several indexes used, that enables to evaluate effectiveness of progressiveness in a country (Duncan, 2014).

Measurements of progressiveness structure may be calculated by reducing average tax rate on gross income, by using data of GDP per capita that is divided into hundred elements within some period of time. Incline of this ratio, reflects tax rate changes when gross income changes by one percent. Zero incline indicates that tax system is proportional, positive incline identifies – progressive system, negative incline – regressive system. If majority of citizens do not pay income tax (in this case they have proportional system and zero tax rate applied while calculating progressiveness may cause structural progressiveness to be close to

zero), rest of citizens (taxpayers) will be a part of progressive system. Due to this reason, structural progressiveness might be significantly different from nominal progressiveness (especially in low income countries) (Duncan, 2014). Situation when tax rate is calculated based on income level, that none of citizens of country have reached, illustrates that system can be progressive even though it does not have any or very low impact on country`s collected revenue from tax. It also highlights importance of structural progressiveness calculation (Rhee, 2012).

Furthermore, Musgrave and Thin (1948), suggests the use of the following formula as a relative tax progressivity index:

$$B_{M}^{2\,n}(y,t) = \frac{1 - G^{n}(y)}{1 - G^{n}(x)} \qquad (1)$$

This index uses Gini coefficient, reflecting social inequality in society. Index reveals how income inequality changes in relation to income tax rate change. Progressive tax application increases Gini coefficient before tax application and it is higher than Gini coefficient after tax application.

Analyzed indicators/coefficients are related to each other, however it identifies uneven facts and causes different conclusions. Moreover, application and analysis of few models may formulate one-sided opinion or misleading results, therefore confusion avoidance needs to be ensured by analyzing whole situation and different points of view.

# 2. METHODOLOGY OF TAX FUNCTIONS ANALYSIS

Every country has its own tax system that determines tax declaration and collection procedures. Collection of data from EU member states enables to compare, evaluate and analyses existing systems (e.g. highest and lowest tax rates applied, percentage of personal income tax in whole tax system) and other related indexes, moreover, this data is a key source for income progressiveness measurement.

Almost 80 % of EU member states applied progressive personal tax system in 2015 (Eurostat data), rest of members states applied proportional system with some exceptions on social groups or tax-free incomes. It is common practice that tax system of the country raises many discussions, opinions and is being challenge for its effectiveness. Progressive tax implementation topic in Lithuania has been discussed for quite some time already, whereas Belgium used this system till 2008, when it was replaced by proportional tax system.

Financial crisis in 2008 caused many economic challenges for countries therefore many of governments were obliged to increase income tax rate. For this reason, in comparison to 2008 level, average of income tax rate increased from 1,39 % to 39,38 %. However, data of recent years reveals that increase has become insignificant and has low impact on EU level.

„Taxation Trends in the European Union“ (2016) states that Sweden, Portugal and Denmark, applies highest personal income tax rates that are higher than 55 %. Moreover, around 62% of member states have applied income tax rates on wealthiest people that were higher than 40%. Interval in countries that have proportional tax systems, varied between lowest of 10 % in Bulgaria and highest of 24% in Latvia.

Evaluation of proportion of personal income tax in total view of country`s tax revenue, reveals, that this indicator is highest in Denmark, Sweden and Ireland, lowest – in Bulgaria, Cyprus, Check Republic. Indicator is significantly high in most of EU members states, moreover in more than half EU member states, collection of personal income tax impacts around 7,4% of country`s GDP, therefore inadequate decisions related to changes within tax system, or tax rate, may impact significant fluctuations of country`s budget and economic situation. Figure below, shows that in Denmark, this amount reaches around 24%. It also shows proportion between GDP and country`s tax revenue. It identifies influence of tax system to GDP : in majority if EU member states, this indicator varies between 30-50%, and is less than 30% in 6 countries. For example, in Ireland, personal income tax consists 30% percent of total country`s tax revenue, however that is only around 10% of total GDP of a country.

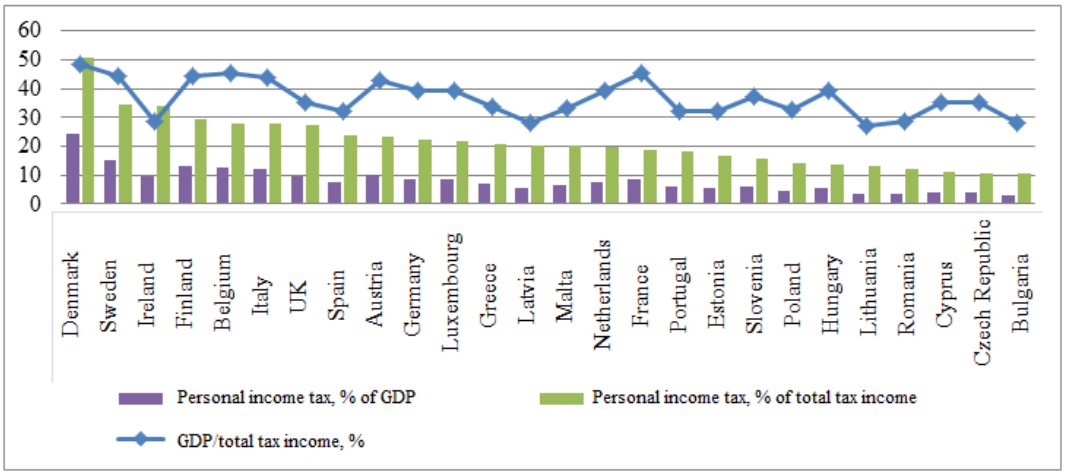


Figure 1. Personal income tax within GDP and within total tax income in 2012

Data source: (http://ec.europa.eu/eurostat/data/database)

Conducted analysis reveals that due to differences among countries` tax systems it becomes challenging to apply comprehensive evaluation of it within EU. For this reason, evaluation of EU progressiveness is based on further analysis of specifically selected EU member states: oldest EU member state – France, Denmark – applying one of the highest tax rates of progressive system, Bulgaria – that has lowest tax rate and changed progressive tax system to proportional, Belgium – that has one of the highest relative tax system impact to GDP and Lithuania – that has been considering progressive tax system application.

As it was mentioned before, main objectives of the country within application of tax collection is effectiveness assurance of fiscal, distributive and regulatory functions, as it enables to formulate country`s budget, distribute it efficiently and in this way, stimulate economic growth and control in a country. Inadequate tax system, may have extreme negative consequences: reduction of country`s budget revenue, increase of public debt, decrease welfare of society or encourage economic crisis. For this reason, in order to evaluate application of progressive tax system to people of EU member states, it is important to take into consideration effectiveness of all three objectives (fiscal, redistributive, regulatory) implementation, evaluate possible alternatives and developments.

Detailed description of research methodology provided below.

First part of research evaluates selected countries : France, Belgium, Denmark, Lithuania and Bulgaria – analysis of personal income taxation systems, tax rates, changes of tax rates, exemption of tax has been conducted. Moreover, data of country`s revenue, tax proportion in country`s budget, average of personal income and personal income tax, tax administration costs has been collected and analyzed. Furthermore, conducted revision of tax

reforms and its results, enabled to understand possible system changes ant operation of tax system.

Second part of research, analysis effectiveness of tax function in selected countries. In order to evaluate fiscal function, dependencies between budget deficit level, average rate of personal income tax and highest personal income tax rate have been analyzed and significance of these indicators to operation of fiscal function.

Progressive income tax system should facilitate redistributive fiction and improve its results. To evaluate this approach in practice, dependency of collected personal income tax revenue on highest personal income tax has been analyzed. Moreover, it was analyzed if higher tax rate, leads to increase of country`s tax revenue. Furthermore, analysis investigated distribution of incomes, tax costs and disposable income based on decillion data. Effectiveness of progressiveness has been analyzed within personal income and expenses distribution either.

Last part of research is evaluating not separate countries, but common EU data. One year data was selected to determine if indicators of separate countries have a tendency to be dependent while evaluating operation of tax function and mostly focusing on progressive tax analysis. In this case, fiscal function was associated to dependency of budget deficit on personal income tax rate, highest personal income tax rate, amount of government's expenses and personal income tax in GDP composition. Redistributive function was analyzed evaluating personal income tax composition`s in GDP dependency on average personal income tax rate and average annual net salary. Regulatory function was evaluated within dependency of unemployment rate on average personal income tax rate, highest personal income tax rate and average annual net salary.

In order to evaluate impact of progressive tax on some indicators, twin studies and multiple models of regression were used. Created equation, reveals connection and its intensity between dependent variable and independent variable. Result analysis enables to evaluate if progressive tax is significantly important to economic growth of the country.

Regression analysis model requires calculation of correlation coefficient of variables. If coefficient is higher than 0 – correlation is positive, if coefficient is lower than 0 – correlation is negative. Value within 0,9 – 1 implies very strong correlation, value within 0,7 - 0,9 implies strong correlation, average correlation is within 0,5 - 0,7, low correlation is within 0,3 -0,5, very low correlation is within 0 - 0,3. Negative correlation if spread within same level if intervals.

In multiple model of regression, intercorrelation is identified when correlation coefficient is higher than 0,8. Factors, that do not meet requirements – need to me corrected or

eliminated from mode. Method of least squares is used to calculate regression estimators, once primary regression equation concluded model significance is checked using F-test. Model is significant if theoretical value of F-test is lower than computed F-test. Additionally, coefficient of determination is applied – it is a number that indicates the proportion of the variance in the dependent variable that is predictable from the independent variable. If value is higher than 0,25, implies that model is eligible.

In order to leave only significant indicators within the model, based on Student's t-test inadequate estimates while using Backward Euler method. Estimate is significant if calculated t-test statistic is lower than theoretical t-test statistic. Final equation is checked against heteroskedasticity and autocorrelation. Heteroskedasticity can be evaluated graphically or applying Goldfeld–Quandt test to check estimates separately. Autocorrelation is evaluated using Durbin–Watson test. Estimation of d is compared with lower estimate $d_L$ and upper estimate $d_U$.

$$DW = d = \frac{\sum_{i=2}^{n} (e_i - e_{i-1})^2}{\sum_{i=2}^{n} e_i^2} \qquad (2)$$

$e_i$ –error, o $e_{i-1}$ – error of previous study, delayed error

Possible results:

- when $d_U \le d \le 4 - d_U$ autocorrelation does not exist;
- when autocorrelation is $d \le d_L$ (positive autocorrelation exist), when $d \ge 4 - d_L$ (negative autocorrelation exist);
- when $d_L \le d \le d_U$ or $4- d_U \le d \le 4 - d_L$ (index d is within uncertainty interval), therefore no observations regarding autocorrelation are possible.

Correct model can be used for analysis and prognosis of research data, however it is necessary to evaluate if dependency is not occasional.

Results of this research enabled to compare results among countries, analyses factors that have the most significant impact on effectiveness of tax system, identify countries that are most successful collecting and distributing tax income in order to ensure social and economic welfare. Research also evaluated impact of world or EU economic fluctuations on personal income and tax application and generalized insights on existing personal income tax systems provided.

# 3. ANALYSIS OF PERSONAL INCOME TAX

## 3.1. Personal income tax in Bulgaria

As stated in earliest chapter, until 2008 Bulgaria had progressive personal income tax system. In 2003 country`s Institute of Market Economy presented alternative budget based on lower tax rates and stated that application of new system would encourage economic growth and improve quality of life for country`s people. At that time, lowest tax rate was seeking 15%, highest – 29%. Suggested reform proposed reduction of income tax, personal income tax and social security payment by 10% (Kostadinova, 2013). Country`s tax rate fluctuations were continuing within 2003-2007 (Appendix 1) and at the end of 2007 there were three tax rates of 20 %, 22 % and 24 % applied within country. In 2008 proportional tax system was introduced: non-taxable income and tax exemptions were eliminated, tax rate of 10% was applied (as mentioned before, it is lowest tax rate within EU) (Vasilev, 2014). Personal income tax in a country, forms 10,5% of total country`s tax revenue and only 2,9% of country`s GDP (Eurostat, 2015). Current personal income tax system applies tax to both residential and non-residential income which source is Bulgaria. There are some exceptions of income that do not have tax application in this country (e.g. home sale, insurance allowance). Moreover 60 % of farm business income, 25 % of lawyer income and 10 % of income from rent have 0% of personal income tax rate applied. Some tax deductions are applied on social and health insurance, charity organizations, interests rates on real estate loans for young families (Taxation trends in the European Union, 2015).

Main objectives of reform in 2008 were seeking to simplify tax system itself and reduce administrative costs. Moreover, it was striving to reduce grey economy level and increase country`s revenue, to reduce unemployment rate by creating new vacancies (Petkova, 2012). Director of Tax Policy Directorate Lyudmila Petkova states, that proportional tax system is less complex for tax payers and tax administrators in comparison to progressive system. It facilitates tax calculation and payment control, therefore reduces system operational costs. Index of operational costs, depends on effectiveness of tax administrators, changes of tax rates, high investments, changes within responsibilities of tax administrators (Tax Administration, 2013). Based on table below, significant change of tax collection index is identified in 2006, due to transfer of social security tax payments collection to National Revenue Agency. Index reduced from 3,18% to 1,68%, it was affected by increase of general tax revenue either.

Within reform implication index fluctuations were not significant, and after it was slightly increasing, while implicating that reformation was beneficial in respect to reduced costs as tax revenues for that time was significantly reduced.

In order to evaluate effectiveness of tax collection it is important to take into consideration the impact of economic situation, therefore it is needed to evaluate dynamics of relative, administrative costs and GDP values prior and after implementation of reform (figure below). Due to increasing economy, reduced costs of tax administration in 2006 are significant – cost and GDP ratio reduced by 0,69 in comparison to 2005. Country`s GDP significantly reduced (by 4,9 %) in 2009, due to global financial crisis, however it is worth to mention that ratio of tax collection and GDP for at time was stable, indicating that applied reform reduced administrative costs and one of objectives of tax reform (tax collection simplicity) was accomplished.

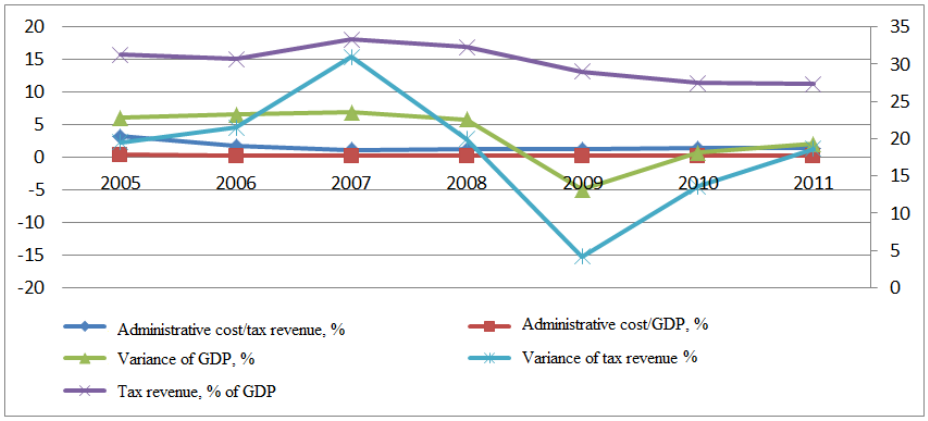


Figure 2. Administrative cost in comparison to tax revenue and GDP in Bulgaria 2005-2011

Data source:

(http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tec00115&language=en)

Minister of Finance states, that implementation of reform, leads to reduction of tax evasion rate either. Elimination of different rate applications, reduces the need and opportunity to reclassify income (Tax, 2012). It is challenging to evaluate impact of reform to increased number of taxpayers when tax rate is reducing. Center for the Study of Democracy conducted research which states that at the time (2003) when public discussions about possible reduction of personal income rate started, around 5,89% of employees were working without contract and were avoiding tax, whereas 77,39 % of employees that had second job, where hiding its income in order to avoid tax application. This indicator was reducing within period of reform application, in 2008 there were 5,59% of employees working without contract and 51,49% of employees that had second job, where hiding its income. Even though this tendency was affected by global economic crisis, later on, in 2012 indicators were still lower as 2,9% of employees were hiding income of primary work and 28,9 % of employees

were hiding income of second job (Dzhekova, 2014). One of the possible reasons for this tendency is associated to reform application.

Minister of Finance states, that reform had an impact on reduction of unemployment rate. It reduced by 1,3 % in 2007-2008 (Appendix 3) and was reducing within whole time period of reform implementation. However, unemployment rate was reducing by 1,8 % even before public discussions of tax reduction in that had started in 2002. Moreover it could be that positive tendency was influenced by growing economy of EU, as in period of global economic crisis it began to increase in 2009 and even reached 12,8 % in 2013. After it, rate has been decreasing and based on February 29th, 2016 data, reaches 8%. For this reason, there is a doubt if reform implied benefit to this tendency at all, or its effect might be for short-term only.

Other objective of reform, was dedicated to improve tax collection process. Reports (Appendix 5) of Minister of Finance show, that revenue from personal income tax to country`s budget increased by 8.9 % when reform was finalized, and by 3.9 % in 2009. Even though, this indicator reduced by 0.9% in 2010, it was once again increasing in later periods. Increase of indicator, was mostly due to income from employment income tax which was increasing yearly. Even though general income indicator shows advantages of reform application, it is important to evaluate country's economy at that period of time. Data of real GDP (2005-2011) and data of personal income as a percentage of GDP (2004-2011) enable to evaluate changes of collected personal income tax under specific economic situation.

Within first year of reform, real GDP was increasing by 5.79% - economy was increasing, however revenue from personal income tax consisted only 2.89% of country`s GDP and real variation of income from this tax in comparison to previous year is -3.59%. In later periods, variation of income from this tax did not exceeded 2 %. For this reason, it is possible to state that there were no significant positive impact of applied reform to country`s budget in nether long-term nor short-term periods.

### 3.2. Personal income tax in France

Top statutory personal income tax rate in France, reaches 50.30 % (18.8 % of all collected tax). Tax system in this country is classified as complex, applying high rates and having high tax administration costs. Income from personal income tax, reaches only 8.5 % of country`s GDP, in comparison to other EU member states it is around 0.9% more than EU average (Eurostat, 2015). Residents of France are obliged to pay foreign income tax based on

progressive tax rates. Based on 2015 data, amount of 9690 EUR in non-taxable, 14% tax applies to income within 9691-26764 EUR, 30 % applies to income within 27765-71754 EUR, 41 % tax applies to income within 71755-151956 EUR. Personal income that are higher than 151956 EUR have 45 % tax rate applied not to all amount, but to separate income parts within threshold. Ch. Seidl identifies this as complex taxation principle.

It is important to notice, that there are exceptions, allowing to reduce amount of taxable income within this system. There is a general abatement of 10% for professional costs in relation to salaries and business earnings up to a maximum of €12,186. This abatement is calculated after the deduction of social security contributions. The minimum abatement is €426 (French Property, 2015). Moreover, there are also tax allowances applied for families that raise children, elder or disable people, charity organizations or investments within country (e.g. innovative companies, woodland, tourism properties).

2006-2008 data, reveals uncommon tendency in this country, as while GDP was increasing, ratio between administrative costs and GDP was significantly reducing (appendix x). Data of later years, reveals that in context of country`s economic growth, administrative costs were stable and consisted 0.19% of GDP. As mentioned before, personal income tax constitutes around 8.5% of country`s GDP (other tax commonly constitute around 44.9 % of GDP), therefore it is more complicated to penetrate ratio of administrative costs and total budget revenue to changes within personal income tax (Eurostat, 2015). Even though, personal income tax is not very significant within country`s budget, data of 2003-2012 reveals that share of this tax in country`s budget, changed disproportionately when country`s income was increasing. In 2012 GDP of France increased by 0.29 % only, amount of personal income tax collected increased, its level within GDP increased by 8.96% compared to 2011. This significant change was influenced by reform applied at the same time. In 2010, budget deficit of France reached 7% (due to impact of global economic crisis). Country was seeking to reduce it 3% and meet Eurozone requirements at the same time. In order to reach this goal, country needed 30 milliard and 2/3 had to be covered within tax burden increase. 10 milliard needed to be covered from personal income tax revenue, therefore it was decided to apply this tax burden to wealthiest people of the country (Douvier, 2012). In 2012 personal income tax increased and reached 18.9 % of all tax collected (previously this indicator was around 17.7 %). This change was caused due to: increased average income tax rate (by around 8.34%), country`s economic growth, increase of people wages. Reform was successful – country reduced budget deficit by 40.9 % (compared to 2011). In 2015 it reaches 4%, based on recent data 3.6% in 2016. From 2014, country is reducing tax burden for people who receives lower

income, that is estimated to affect around 4.18 million households, in this way, country constantly seeks to improve country`s financial situation and people`s welfare (France, 2014).

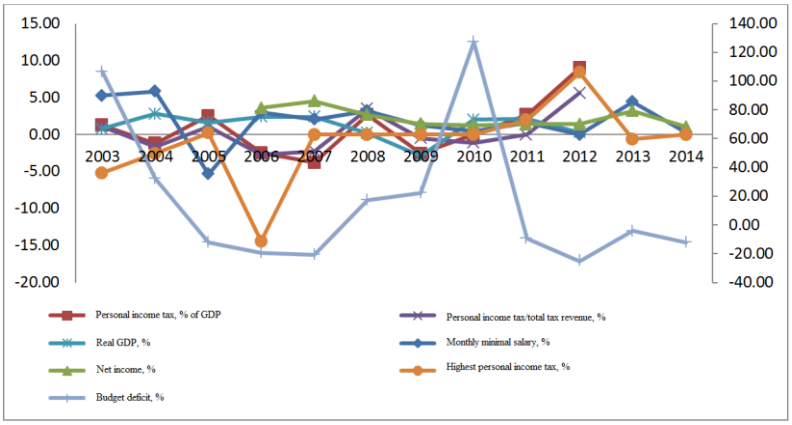


Figure 3. Personal income tax within GDP, total tax revenue, real GDP, minimal monthly salary, net income, highest personal income tax in France 2003 – 2014.

Data source: (http://ec.europa.eu/eurostat/data/database)

### 3.3. Personal income tax in Denmark

Personal income tax rate is one if the highest with EU member states. As per recent data, and reaches 55.8 %. Herewith, it combines almost 50% of all country`s tax revenue (social security is funded from direct tax) and comprises around 24.9 % of country`s GDP (Trading Economics, 2016). High tax rates in Denmark are applied to people who earn low income either. Highest peak of personal income tax was reached in 2010, when it was around 62.9%, however, the same year, tax reform was confirmed. Its objective was to encourage supply of labor force in long term, decrease impact level of global crisis to the country in short-term, therefore initiative of general tax rates reduction was presented (Danish Tax, 2010).

Tax that composes personal income tax in Denmark:

Labor market contribution of 8% of your entire income – applied to all employees and self-employed workers.

Health contributions of 5% - proportional tax, applied to people who earn 43,400 DKK (under 18, 32,600DKK) per annum.

Municipal tax of 0.89 % (on average) - each municipality determines the tax rate for the people living there. Tax is applied to people who earn 42800 DKK (5,4 % deduction is possible for single parents).

Church tax of 1.51% (on average) - each church determines the tax rate for the people living nearby. Tax is applied to people who earn 42800 DKK

State tax – applied to income that exceed two possible limits: bottom-bracket tax 6,83 % - applied to people who earn 42800 DKK, top-bracket tax - applied to people who earn 459,200 DKK (Your Europe, 2016)

Based on tax spread above, it could be stated, that personal income tax in Denmark May vary between 8 % -56 % (Taxation trends, 2014). It is important to mention that while calculating personal income tax rate, capital income is added to salary income (except applying social tax). Since 2010, if capital income is under 40000 DKK – 37.5 % tax rate is applied, if capital income is over 40000 DKK – 42.7 % tax rate is applied. Income earned from stock, have tax rate application within 27% - 42 % , depending on income level. Tax deductions and allowances are applied to pension contributions, childcare, loan interests, transportation costs (Tax in Denmark, 2015). As country applies many rules and allowances, exact personal income tax rate applied is calculated based on specific situation.

Tax administration costs in Denmark are around 0.69 % of all tax revenue. It is also 0.29% of country`s GDP. Analysis of figure below reveals that when country`s tax revenue increases, ratio of tax administration costs and income is reducing. When country`s tax revenue decreases, ratio is increasing. It means that dependency between tax revenue and tax administration costs is reverse. Similar tendency is seen between ratio of expenses and GDP.

In 2010 Denmark had significant changes due to beginning of tax reform. Administration costs increased at that time as there were new means applied to ensure effective tax planning, tax claiming and tax payment (Danish Tax, 2010).

As mentioned before, one of reform`s objective, was to encourage supply of labor force in long term, therefore tax rate was reduced in order to increase level of person`s disposable income. Practical evaluation of this process, needs to analyze actions, tax rates, personal income - prior implication of changes, and of course – its post impact. In period of 2004-2013 7.7 milliards EUR were given for improvements to this area on yearly basis. Highest part of funding (around 39%) was not dedicated to increase wages, 16% was appointed for employment maintenance or for reintegration to labor market process.

Distribution of expenses within analyzed period was uneven and significant increase is perceived in 2008, most probably due to beginning of global economic crisis. However in 2010 it is noticeable that expenses for employment promotion increased by 20.9 % in comparison to 2009. Analysis of people who receives lowest income, enables to evaluate benefit of these system changes. As expected, in 2005-2007 personal income tax rate was stable – 38.9 %, however since 2008, rate started to decrease (around 0.9 % per year) and in

2010 decreased by 3.41 % as per reform applications. Till 2013 low rate increase is identified, however in later periods rate starts to decline. It is important to mention that personal net income were increasing every year by 2.9% on average, and no indications of income reductions noticed. For this reason, it is possible to expect that if economic situation and employment policy of country is not changing, results in labor market will be improving in long term perspective. Moreover, GDP increase within 2010-2011 indicates that applied reform may not have significant harmful consequences for country`s budget (Eurostat, 2015).

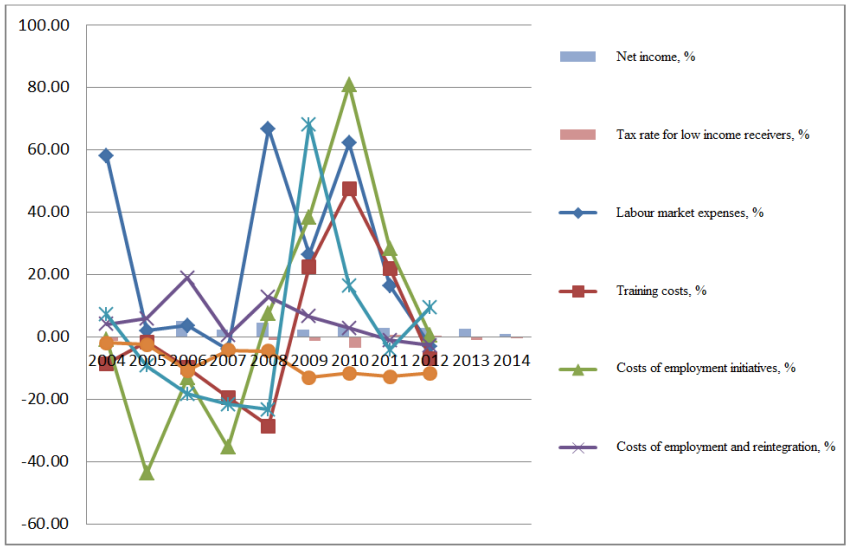


Figure 4. Labor market expenses, net income, tax rate for low income receivers, variances in 2004-2014
Data source: (http://ec.europa.eu/eurostat/data/database)

### 3.4. Personal income tax in Belgium

Belgium is one the EU country, where people pays significantly high personal income tax. Top statutory personal income tax rate in 2015 reaches 53.8% (Taxation trends in the European Union, 2015). This tax constitutes 1/3 of total country`s tax revenue and is 12.69% of country`s GDP (Eurostat, 2015). Tax system in Belgium is progressive and has 5 different tax rates, that are applied based on amount of income received. 25 % tax rate is applied of person`s earnings are lower than 8710 EUR, 30 % tax rate is applied of person`s earnings are within 8710-12400 EUR, 40 % tax rate is applied of person`s earnings are within 12400-20660 EUR, 45 % tax rate is applied of person`s earnings are within 20660-37870 EUR. If person`s income are higher than 37870 EUR, two rates will be applied to different amount of income that in total could reach rate of 50% (Belgium, 2015).

As in Demark, in this country municipal tax in range of 0-9% is applied. Each municipality determines the tax rate for the people living there, is able to increase it or apply allowances. Based on 6th reform (January 2015), personal income tax of 25% became regional tax that is proportional against registered place of residence.

There are four groups of income identified in this country: employment income, income from real estate, income from investment activities and other additional income. Additional rules may apply, based on income source and to which group income belongs to. Employment income may be reduced by experienced costs of fuel, car maintenance, representative costs or within application of maximal fixed deduction rate (in 2015 it was 3950 EUR). Some more deductions are applied to country`s residents, e.g. 4.5% standard rate for investments to new real estate, or up to 80% to alimony income. Tax allowances are also applied for childcare, life insurance income, pension, loan interests, investments to shares. Moreover, as of 2015, 7000 EUR was set as non-taxable amount for each taxpayer.

As Hungary and Holland, Belgium is one the countries, that has highest tax administration costs. In 2005-2011 these costs reached almost 0.34 of country`s GDP, and 1.34 in comparison to total country`s tax revenue (Tax Administration, 2013). Indicators within years in relation to each other, states that administrative costs of this country is consistent, therefore it indicates stability of the system, however that reduces flexibility of tax system itself and is needed in moments of recession.

Table below, confirms previously mentioned stability of personal income tax in Belgium. Highest personal income rate is stable till 2003 (53.7% - 53.8%), fluctuation of personal income tax in GDP structure, have not exceeded 3.9% percent. Low fluctuations is applicable while analyzing personnel income tax addition within total country`s tax revenue. That could be explained due to stable country`s economy and stable GDP increase (by 1.29% on average). Budget deficit of a country is decreasing in recent years and is indicated as -2.6 % (Trading Economics, 2015). Moreover, it is worth to mention that minimal wage in a country is increasing by 1.9 % on average every year and net income level – by 2.9% (Trading Economics, 2015). Economic stability of the country, causes increase of personal income and general welfare for county`s people, despite of the fact that Belgium has one of highest personal income tax rate.

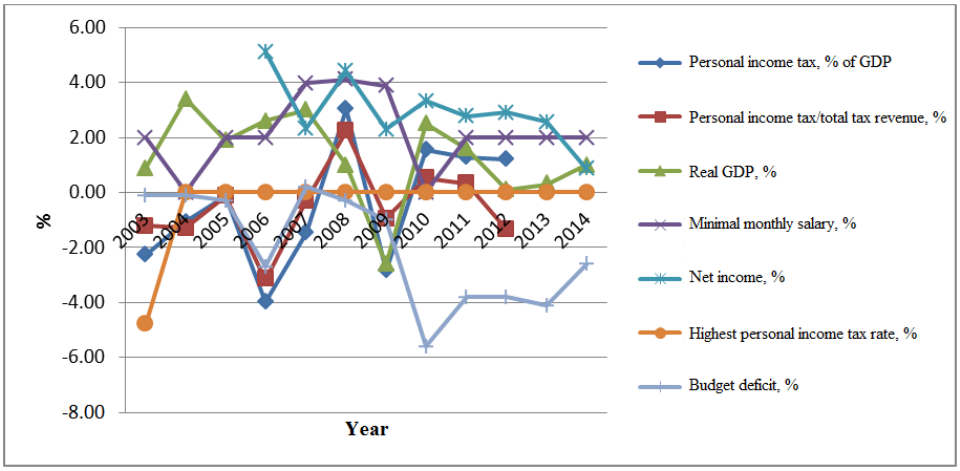


Figure 5. Personal income tax within GDP, tax revenue, real GDP, minimal monthly salary, net income, highest personal income tax rate and budget deficit in Belgium, 2003-2014

Data source: (http://ec.europa.eu/eurostat/data/database)

### 3.5. Personal income tax in Lithuania

Lithuania is applying proportional tax system due to ensure competitive advantage internationally. Current level of this tax income, has a low impact to country`s GDP. Report of country`s Finance Minister, states that in 2015 personal income tax revenue was 387.822 Within EU level, lower amount is collected in Bulgaria and Slovakia. Personal income tax consists 12.88 % of total country`s tax revenue, and it is lower by 1.59 in comparison to EU member states average (Eurostat, 2015).

Personal income tax is applied to majority of possible income, however there is division existing in context of payment of these tax. A class income (salary) is responsibility of legal person (application and declaration functions), B class income (individual activities, lottery winnings, property sale) needs to be calculated, paid and declared by individual.

As in other EU member states analyzed, Lithuania tax allowances are also applied for bank deposits, charity, childcare, compensations, gifts, alimony and other. Base level of personal income tax rate is 15%, however some exceptions exist: income from distributed profit has 20% tax rate applied, income from individual activities has 5% tax rate applied. Holders of business license, pay fixed tax rate, applied by municipality.

It is important to mention that non-taxable amount calculation is partly progressive in Lithuania. By applying specific formula (e.g. if person earns 290 EUR, tax allowance of 166 EUR may be used) non-taxable amount is decreasing if personal income is increasing. Once results becomes negative, no tax allowance is applied. It is important to mention that due to tax allowances that country provides, significant losses to country`s budget are identified. For

this reason, country`s ax system is being criticized as it does not implement one of its key functions – insurance of sufficient country`s revenue level. Moreover, it falsifies tax base and digress from one tax rate application (Paulauskas, 2008)

Proportional tax rate, should simplify tax income collection and reduce its administration cost, however data f 2005-211 and its comparison to Denmark, Belgium, France, Bulgaria does not prove or distinguish Lithuania`s tax system as the most effective. This mostly caused due to wide tax allowance implications, largeness of grey economy and level of unassembled income. Significant unusual changes, within tax system have not been identified. Since 2011 significance of personal income tax within general tax system is increasing and is second most important tax (VAT is in the first place) Taxation trends in the European Union (2015). Personal income tax level within country`s GDP is reducing since 2006. As GDP change within analyzed period was positive, it can be stated that collection effectiveness of personal income tax is not changing. However, it may be impacted by level of migration or increasing wages (around 5,39% increase in 2015). As every country, Lithuania's government is seeking to collect sufficient level of income to its budget, therefore there were many public discussions and suggestions to replace current system with progressive tax system.

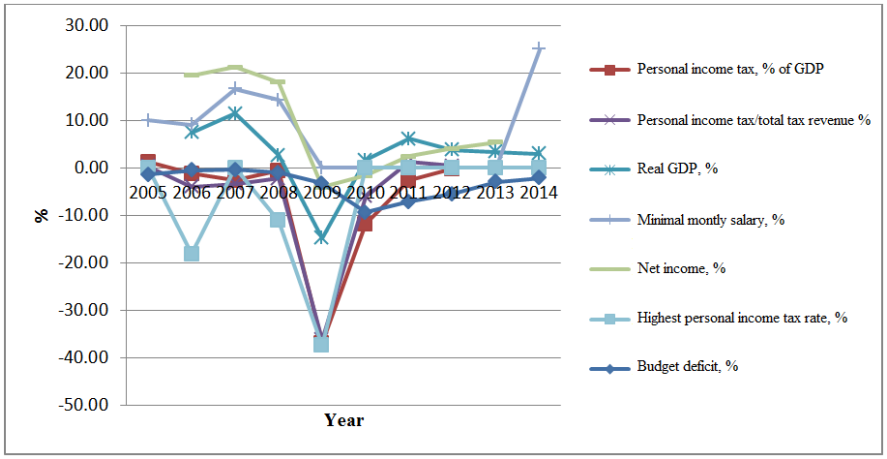


Figure 6. Personal income tax within GDP, tax revenue, real GDP, minimal monthly salary, net income, highest personal income tax rate and budget deficit in Lithuania, 2005-2014

Data source: (http://ec.europa.eu/eurostat/data/database)

Analysis of personal income tax in Denmark, Belgium, France, Bulgaria, Lithuania, enabled to understand main principles of tax system, need of reform implementation and its possible results. Even thought, each country applies different rules or systems, key objectives and reasoning of income taxation are similar, therefore appropriate techniques needs to be aligned to country`s social and economic situation.

# 4. ANALYSIS OF TAX FUNCTIONS

## 4.1. Impact of progressive tax system to fiscal function

Countries are using fiscal policy in order to reduce unemployment level, inflation level improve country`s economy. Main objective of fiscal policy is to ensure effective budget formation while regulating income and expenses of a country. Income from tax has significant role in this process. However, tax and tax systems are different, therefore level of impact to fiscal function is diverse

In this chapter, impact of personal income tax to country`s` budget deficit will be evaluated for Denmark, Bulgaria, France, Belgium and Lithuania. Assumption has been made, that due to effective budget formulation, expenses will not exceed country`s income, budget will be balanced or with surplus.

Firstly, analysis of personal income tax (x-average personal income tax rate of average salary) impact on country's budget deficit conducted (y - country's budget deficit). Data of World Bank and Eurostat used within period of 1999-2015. It is expected that if x is increasing, y is decreasing (Appendix 10). It is important to mention that dependency analysis is conducted within separate calculations for each country.

Based on results provided in appendix x, average personal income tax rate has an impact on country's budget deficit: results of correlation coefficient are within 0,483-0,684 (table below) under both: progressive and proportional tax systems. T-test statistics reveal that x indicator in conducted multiple regressions is significant. This enables to state that changes of average personal income tax rate will impact country's budget deficit. It is important to notice that differently from other countries in Belgium, budget deficit was increasing even though average personal income tax was increasing. It could indicate that country has immoderate tax rates or tax system itself is not efficient. If we assume that higher average personal income tax indicates higher progressiveness, it can be implicated that proportional and progressive personal income tax will be impactful to country`s budget formation. However, due to country`s tax system the impact will not necessarily be positive to country`s budget deficit.

Table 1. Average personal income tax and budget deficit dependency`s correlation, determination coefficient, estimated and theoretical t statistics, regression equations.

| | Lithuania | Bulgaria | Belgium | Denmark | France |
|---|---|---|---|---|---|
| Correlation coefficient | 0,661 | 0,649 | 0,684 | 0,647 | 0,483 |

| | | | | | |
|---|---|---|---|---|---|
| Determination coefficient | 0,437 | 0,421 | 0,467 | 0,419 | 0,283 |
| Estimated t statistics | 2,786 | 2,696 | -2,962 | 2,683 | 2,356 |
| Theoretical t statistics | 2,228 | 2,228 | 2,228 | 2,228 | 2,145 |
| Equation | y = 0,39x - 10,55 | y = 0,23x - 4,37 | y = -3,77x + 157,23 | y = 1,63x - 64,41 | y = 1,87x – 56,7 |

(Data source: Trading Economics, World Bank, Eurostat)

Secondly, analysis of personal income tax (x – highest personal income tax rate) impact on country's budget deficit conducted (y - country's budget deficit). Data of World Bank and Eurostat used within period of 1999-2015. It is expected that if x is increasing, y is decreasing (Appendix 10 ). It is important to mention that dependency analysis is conducted within separate calculations for each country.

Results of correlation coefficient, identifies similar dependencies in all analyzed countries (Appendix 10) – if highest personal income tax rate is increasing, budget deficit of country is decreasing. T-test statistics and determination coefficient confirms that created estimates for all analyzed countries are significant. As mentioned in previous chapter, tax rate in Bulgaria was reduced after reform implication, therefore it could be the case that change from progressive tax system, to proportional tax system enabled to formulate country`s budget effectively. As analysis cover countries using both systems, similar results may imply that proportional and progressive systems can be equally effective to implementation of fiscal function.

Table 2 . Highest personal income tax rate and budget deficit dependency`s correlation, determination coefficient, estimated and theoretical t statistics, regression equations.

| | Lithuania | Bulgaria | Belgium | Denmark | France |
|---|---|---|---|---|---|
| Correlation coefficient | 0,638 | 0,625 | 0,498 | 0,636 | 0,558 |
| Determination coefficient | 0,407 | 0,391 | 0,248 | 0,405 | 0,312 |
| Estimated t statistics | 2,622 | 2,534 | 2,151 | 2,607 | 2,428 |
| Theoretical t statistics | 2,228 | 2,228 | 2,145 | 2,228 | 2,16 |
| Equation | y = 0,26x- 8,97 | y = 0,19x-3,92 | y = 0,35x-21,03 | y = 0,59x-34,13 | y = 0,19x- 13,5 |

(Data source: Trading Economics, World Bank, Eurostat)

Results of both conducted analysis, enables to summarize, that proportional and progressive personal income tax impacts country`s budget formation. However, due to country`s tax system and administration the impact will not necessarily be positive to country`s budget deficit. Moreover, level of personal income tax impact, depends not only on

selection of tax system, but on system structure, tax rates or income plot that are chosen. Lastly, proportional and progressive systems can be equally effective to implementation of fiscal function.

### 4.2. Impact of progressive tax system to distributive function

As discussed in previous chapters, effective tax system may bring positive results to implementation of distributive function. Before distribution of tax income, country needs to ensure that tax collection would be effective, therefore it could be stated that the most suitable tax system should ensure highest income tax to a country.

It is challenging to identify only one tax system, describe its structure, rates, as social, economic situations within countries are highly different. Therefore below analysis seeks to evaluate if progressive tax impacts volume of collected tax and how this volume differs within proportional tax system. In calculations below, x is highest personal income tax rate, y is country`s tax revenue. Data of World Bank and Eurostat used within period of 1999-2015. It is expected that if x is increasing, y is increasing either (Appendix 11).

Objective of this analysis is not to evaluate distribution itself, for this reason assumption, that income is distributed more effective if collected tax revenue are higher, is applied. Under this assumption, effect of personal income tax on country`s tax revenue is analyzed within five selected countries (France, Denmark, Lithuania, Bulgaria, Belgium) (Appendix 11). Data analysis reveals that correlation coefficient is negative for all analyzed countries. It may imply that applied rates are too high, possible tax avoidance or that other tax are more significant in comparison to personal income tax.

Determination coefficient and t-test statistics results implies to reject regression equation for Lithuania, as x indicator is not significant and no conclusions are possible to evaluate dependency. Based on results for rest of countries (France, Belgium, Bulgaria and Denmark), it could be stated that reduction of tax rate, could lead to collection of highest amount of country`s tax revenue, however boundary of when revenue increase would stop, is uncertain. Moreover, example of Bulgaria when correlation is stronger due to transfer to proportional tax system and therefore – lower tax rates, successful economic growth, positive income increase results, prevents to assure that only progressive tax system reinforce operation of redistributive function.

Table 3. Highest personal income tax rate and personal income tax revenue dependency`s correlation, determination coefficient, estimated and theoretical t statistics, regression equations.

| | Lithuania | Bulgaria | Belgium | Denmark | France |
|---|---|---|---|---|---|
| Correlation coefficient | 0,191 | 0,926 | 0,780 | 0,568 | 0,883 |
| Determination coefficient | 0,037 | 0,858 | 0,609 | 0,323 | 0,779 |
| Estimated t statistics | -0,647 | -8,144 | -4,140 | -2,491 | -6,225 |
| Theoretical t statistics | 2,201 | 2,201 | 2,201 | 2,16 | 2,201 |
| Equation | y = -14,7x+1891,6 | y = -35,7x+1785 | y = -3680,4x+250120 | y = -2674,4x+225740 | y = -6610,7x+505022 |

(Data source: Trading Economics, World Bank, Eurostat)

Both analyzed functions: fiscal and distributive – are related, therefore common evaluation of results is needed. Country`s budget is dependent on collected income and costs experienced. Results regarding distributive function revealed that correlation between personal income tax and country's tax revenue is significant in Denmark, Belgium, France and Bulgaria, meanwhile results regarding fiscal function revealed that all five selected countries have significant dependency between personal income tax and country`s budget deficit (table below). Evaluation of highest personal income tax rate, country`s tax revenue, budget deficit reveals that significant dependency is existing in Denmark, Belgium, France and Bulgaria. Increase of highest personal income tax rate, reduces country`s tax revenue and budget deficit in all four countries. This unexpected result may be caused by different volume of income and deficit within country, or it could be that people are avoiding tax implications, spends money on goods and services, therefore revenue from VAT or other tax is increasing and reduces country`s budget. Analysis of Belgium case, implies that country applies to high tax rates: as increase of personal income tax, reduces country`s tax revenue and encourages increase of budget deficit. Therefore, reduction of taxes rate may positively affect country`s economy.

All of above allows noticing that progressive and proportional tax rates are significant and has similar tendencies within fiscal and redistributive functions of analyses countries.

Table 4. Impact of personal income tax, to country`s income and budget deficit

| | Lithuania | Bulgaria | Belgium | Denmark | France |
|---|---|---|---|---|---|
| Personal income tax rate | ↑ | ↑ | ↑ | ↑ | ↑ |
| Country`s tax revenue | x | ↓ | ↓ | ↓ | ↓ |
| Country`s budget deficit | ↓ | ↓ | ↓ | ↓ | ↓ |

### 4.3. Impact of personal income tax on regulatory function

Regulatory function, seeks to ensure effective resources management within country`s tax system. It may promote or brake economic activates and influence processes of macroeconomics. In order to evaluate impact of personal income tax on regulatory function, it is analyzed, how increase of earnings affect changes of tax allowances, personal income tax and disposable income. Decilian data of Euromod is selected within period of 2013. (Appendix 12).

Percentage of income, personal income tax, material benefits, disposable income in each decilian group has been measured. Conducted analysis reveals similar results within all selected countries. Due to proper distribution of tax allowances, personal income tax and disposable income increases proportionally in country`s within progressive tax system. In country`s within proportional tax system (Lithuania, Bulgaria) tendencies are similar: personal income tax changes mostly proportionally to increasing income in different deciles in Bulgaria. Meanwhile, in Lithuania, the highest portion of material benefits was received by second decile group and lowest income receivers within first three groups, received around 84.9% of total material benefits. It indicates that large part of people receives low income that is already too high to expect tax allowances. However, disposable income is increasing proportionally to increasing income. In Belgium, Bulgaria, France and Denmark, percentage of material benefit is divided within 6 groups of lowest income receivers. This data enables to state that proportional and progressive tax systems may improve effective regulation of disposable income changes, however not the tax system`s selection, but its components as tax rates, non-taxable income level, tax allowances are more significant.

Analysis of all five countries reveals that personal income tax is significant within fiscal, distributive and regulatory functions. Moreover, it could be stated that both systems – progressive and proportional based on implementation policy within country, may bring effective results within tax functions and may improve economic growth and welfare. Example of Bulgaria reveals that proportional system could encourage effective and stable economy. However it is needed to revise system`s administration, tax allowances, tax rates, and evaluate possible optimizations in order to reach best results. This could be a learning point to consider for Lithuania, due to open discussions of transferring proportional country`s tax system to progressive tax system.

# 5. ANALYSIS OF TAX FUNCTIONS WITHIN EU

## 5.1. Fiscal tax function within EU

This chapter continues to present evaluations of tax functions. However it is dedicated not to specific countries but within EU level. Multiple regression model is used to analyze how average of personal income tax rate (x1- percentage of average calculated to average salary), highest personal income tax rate (x2 – percentage), government's consumption expenses (x3 – percentage of GDP), personal income tax within GDP (x4 – percentage of GDP) affects budget deficit (y - percentage of GDP) (Appendix 13). It is expected that budget deficit decreases, when average of personal income tax rate increases; budget deficit decreases when highest personal income tax rate increases; budget deficit decreases, when government's consumption expenses decreases; budget deficit decreases, when personal income tax within GDP increases.

Data in appendix x13 reveals that correlation coefficients of independent variables do not exceed 0.8, therefore intercorrelation is not identified within it and following equation of primary regression constricted: $y=-4,1+0,04x_1-0,1x_2+0,1x_3+0,26x_4$

F statistics confirmed significance of model itself, hereafter significance of separate indictors was examined. Applying t-statistics within Backward Euler method, identified that average of personal income tax rate - x1 and government's consumption expenses- x3 indicators are insignificant and proved related predictions to be incorrect. Free indicator is not significant as calculated t statistics is lower than theoretical statistics, however, its elimination does not cause average of errors to be equal to zero, therefore free indicator is not eliminated (table below).

Table 5. Budget deficit dependency on model correlation of X indicators, determination coefficient, estimated and theoretical F and t statistics, within EU

| | Primary model | Final model |
|---|---|---|
| Correlation coefficient | 0,577 | 0,566 |
| Determination coefficient | 0,333 | 0,320 |
| Estimated F statistics | 2,874 | 5,877 |
| Theoretical F statistics | 2,796 | 3,385 |
| Theoretical t-statistics | 2,069 | 2,060 |

| | | |
|---|---|---|
| Estimated t-statistics – x1 | 0,464 | - |
| Estimated t-statistics – x2 | -2,600 | -2,618 |
| Estimated t-statistics – x3 | 0,519 | - |
| Estimated t-statistics – x4 | 1,682 | 3,303 |

(Data source: Trading Economics, World Bank, Eurostat)

T statistics are proven to be significant for x2 and x4, therefore following equation of final regression provided: $y=-2,2-0,09x_2+0,34x_4$

Determination coefficient confirms significance of model. Autocorrelation not identified using Durbin-Watson statistics, heteroskedasticity not identified using Goldfield-Quandt test. Equation reveals that increase of highest personal income tax rate encourages budget deficit to reduce. Moreover, increase of personal income tax within GDP, budget deficit increases. Results enables to state that highest personal income tax rate is one of measurements that may impact reduction of budget deficit within EU level. Countries that apply proportional tax system has tax rates that do not exceed 24% (2012-2015 data), higher tax rates are applied within proportional tax system, which leads to conclusion that progressive tax system is more beneficial to countries that seek balanced budget or surplus budget, therefore progressiveness in this case, stimulates implementation of fiscal function.

### 5.2. Redistributive tax function within EU

Further analysis is conducted in order to evaluate redistributive tax function. Multiple regression model is used, where dependent variable is personal income tax within GDP (y - percentage of GDP). Other selected variables were: average of personal income tax rate (x1- percentage of average calculated to average salary), highest personal income tax rate (x2 – percentage), average of annual net salary (x3 - percentage) (Appendix 14). It was expected that : personal income tax within GDP is increasing when average of personal income tax rate is increasing; personal income tax within GDP is increasing when, highest personal income tax rate is increasing; personal income tax within GDP is increasing when average of annual net salary is increasing.

Data in appendix x14 reveals that coefficients of variables do not exceed 0.8, therefore intercorrelation is not identified within it and following equation of regression constructed: $y=-3,08179+0,363551x_1+0,038679x_2+0,000246x_3$

Theoretical F statistics is lower than calculated, and value of determination coefficient is 0.7, therefore model is implied as confirmed significant. Applying t-statistics within Backward Euler method, identified that highest personal income tax rate (x2) indicator is insignificant and proved related prediction to be incorrect (table below). Free indicator is not significant as calculated t statistics is lower than theoretical statistics, however, its elimination does not cause average of errors to be equal to zero, therefore free indicator is not eliminated.

Table 6. Personal income tax dependency on model correlation of X indicators, determination coefficient, estimated and theoretical F and t statistics, within EU

| | Primary model | Final model |
|---|---|---|
| Correlation coefficient | 0,839 | 0,836 |
| Determination coefficient | 0,704 | 0,698 |
| Estimated F statistics | 18,987 | 28,929 |
| Theoretical F statistics | 3,009 | 3,385 |
| Theoretical t-statistics | 2,064 | 2,060 |
| Estimated t-statistics – x1 | 4,135 | 5,202 |
| Estimated t-statistics – x2 | 0,654 | - |
| Estimated t-statistics – x3 | 2,111 | 3,702 |

(Data source: Trading Economics, World Bank, Eurostat)

T statistics are proven to be significant for x1 and x3, therefore following equation of final regression provided: $y=-2,70051+0,392154x_1+0,0003x_3$

Autocorrelation not identified using Durbin-Watson statistics, heteroskedasticity not identified using graphical evaluation. Equation reveals that countries which have higher average of personal income tax rate and higher average of annual net salary, receive higher tax revenue to its budget. Moreover data reveals that country`s which imply proportional tax system, have lower net salary level. However, this tendency cannot be fully linked to tax system, as most of those countries` economies (Romania, Latvia, Lithuania) are weaker in comparison to other EU member states. Countries that have proportional tax system, have high rates of personal income in comparison to countries that have progressive tax system, therefore, percentage of personal income tax within GDP is considerable. For this reason it is incorrect to state that in all cases progressive tax system enables to collect higher tax revenue to countries budget and creates sympathetic opportunities to distribute it.

### 5.3. Regulatory function within EU

Analysis of five selected countries, revealed that disposable income is affected not only by application of progressive or proportional tax, but also is dependent on system`s aggregate, tax allowances applied and other aspects related to taxation. Due to these assumptions, following indicators have been selected for further analysis to evaluate regulatory function. It was analyzed, how unemployment rate (y – percentage of population) is affected by: average of personal income tax rate (x1- percentage of average calculated to average salary), highest personal income tax rate (x2 – percentage) and average of annual net salary (x3 - percentage) (Appendix 15). It was expected that, unemployment rate (y) is reducing, when average of personal income tax rate (x1) is increasing; , unemployment rate (y) is reducing, when highest personal income tax rate (x2) is increasing and unemployment rate (y) is reducing, when average of annual net salary (x3) is increasing,

Data in appendix x15 reveals that coefficients of variables do not exceed 0.8, therefore intercorrelation is not identified within it and following equation of regression constructed: $y=31,1619-0,3403x_1-0,0007x_2-0,0006x_3$

Theoretical F statistics is lower than calculated, and value of determination coefficient is 0.7, therefore model is implied as confirmed significant. Applying t-statistics within Backward Euler method, identified that average of personal income tax rate (x1) and highest personal income tax rate (x2) indicators are insignificant and proved related predictions to be incorrect (table below).

Table 7. Unemployment rate dependency on model correlation of X indicators, determination coefficient, estimated and theoretical F and t statistics, within EU

| | Primary model | Final model |
|---|---|---|
| Correlation coefficient | 0,631 | 0,586 |
| Determination coefficient | 0,398 | 0,343 |
| Estimated F statistics | 5,064 | 13,056 |
| Theoretical F statistics | 3,028 | 4,242 |
| Theoretical t-statistics | 2,069 | 2,060 |
| Estimated t-statistics – x1 | -1,301 | - |
| Estimated t-statistics – x2 | -0,039 | - |
| Estimated t-statistics – x3 | -1,887 | -3,613 |

(Data source: Trading Economics, World Bank, Eurostat)

T statistics is proven to be significant for x3, therefore following equation of final regression provided: $y=26,3719-0,000822x_3$

As mentioned in previous chapter, data reveals that country`s which imply proportional tax system, have lower net salary level. However, this tendency cannot be fully linked to tax system, as most of those countries` have weaker economies in comparison to other EU member states. Due to this reason, even though x3 indicator is confirmed, it will not have significant benefit for analysis and further model inspection is not applied. Data reveals that average of personal income tax rate (x1) and highest personal income tax rate (x2) indicators are insignificant, it enables to state that progressive tax system does not have significant or higher advantage to regulatory function in comparison to proportional tax system. Countries that use proportional tax system, instead of thorough change to progressive tax system, may use existing tax system, apply changes and reach more successful results to solve such problems as unemployment.

Conducted analysis within EU level, reveals progressive tax benefits in comparison to proportional tax system within fiscal function. However it is important to notice that in context of distributive and regulatory functions, both systems have similar significance or the tendency not determined. Both systems may reach economic and social improvements if implementation of system itself is reasonable. Case of Lithuania, would lead to suggestions to maintain current tax system, but focus on possible developments and changes within its operation.

# CONCLUSIONS AND RECOMMENDATIONS

1. Key objectives of tax system is to ensure sufficient income level of income to country`s budget, that could be distributed to ensure protection, education, health protection, law enforcement, effective economy and maintenance of other areas. There are 3 main social objectives raised for progressive tax system. First objective seeks to distribute tax burden from poor to rich people. Second objective is country`s capacity insurance to distribute revenues of society members. Third objective strives to reduce economic and political power of wealthy people. These objectives are oriented to ensure social, economic equality and justice.
2. Progressive tax system performs effectively, it ensures less separation among society members, reduces level of poverty, stimulates consumption of middle-class and productivity. From government perspective, this system enables effective collection of higher tax amounts. Moreover, progressive tax positively impacts operation of automatic stabilizers, therefore stimulates stable growth of country`s economy.
3. Main negative aspects of progressive tax system is its complex administration, bureaucracy and operational costs. Moreover it causes general social inequality, by dividing people to different groups and applying rates, based on income index only. No consideration of education, efforts, reduces significance of career or education and leads to application of highest tax burden to most efficient members of society whose added value is usually highest.
4. Tax progressiveness can be reached within application of different tax rates to specific groups of society members. Moreover, non-taxable volume of income, tax allowances may stimulate progressive taxation, however it will not bring significant benefits to society and increase country`s expenses.
5. There are various indicators, that are used by scientists and economists in order to compare tax progressiveness within different countries. However, results are not always adequate to real situation due to complex data collection, different production of statistical data and grey economy. Avoidance of inexact results may be avoided within application of various indicators and using different statistical data.
6. Most of EU member states apply progressive tax system, however due to different tax rates, non-taxable income levels, tax allowances, system has different positive

(economic growth, welfare of society) or negative (economic declines, people dissatisfaction).

7. Implication of progressive system as effective tool to increase country`s tax revenue and social welfare – is common opinion within public discussions and literature. However, example of Bulgaria reveals that proportional system could be beneficial to small countries and encourage effective, stable economy. It is needed to revise system`s administration, tax allowances, tax rates, and evaluate possible optimizations in order to reach best results.
8. Change implications of personal income tax may impact country`s economy significantly. However it needs to be supported by conducive conditions, such as economic growth, primary investments availability, possibility to apply higher rates to wealthy members of society.
9. Inadequate application of tax allowances will not solve primary social problems, moreover it may reduce country`s budget and falsify tax base. Therefore, selection and implication of tax allowances, needs to be thoroughly planned and realized by specialists.
10. EU and selected countries analysis reveals significant impact of personal income tax to budget deficit and implementation to fiscal function. Moreover, countries under progressive taxation has more effective fiscal function and lower budget deficit.
11. Analysis of redistributive function, reveals that both: progressive and proportional systems are significant to its implementation. Higher income to country's budget may be collected due to effective operation of tax system but not due to type of it.
12. Selected countries analysis reveals both systems: progressive taxation and proportional taxation may create suitable conditions for tax revenue distribution and ensure proportional growth of disposable income within general income growth.
13. EU and selected countries analysis reveals progressive tax benefits in comparison to proportional tax system within fiscal function - H1 hypothesis is accepted. However it is important to notice that in context of distributive function, both systems have similar significance - H2 is rejected. H3 is neither accepted nor rejected as results implies that personal income tax is not significant to indicator chosen to prove its impact.

Recommendations:

1. In order to apply changes within existing tax system or initiate transfer to new tax system, comprehensive analysis of regulatory, distributive, fiscal tax functions and its elements within different countries is useful to evaluate possible results and aftereffects.
2. Progressive tax system, its implication and aftereffects are dependent from specific situation in a country. Incorrect applications of tax allowances, rates, types of tax, may harm any tax system, therefore it is recommended to analyze personal income tax examples in different countries and consequences of such factors as: tax allowance, non-taxable income levels.
3. In order to ensure effective implementation of fiscal, redistributive, regulatory functions, it is necessary to evaluate many different factors: type of tax system, taxation rules, country`s social and economic situation, tax objectives and decisions within it.
4. Example of Bulgaria reveals that proportional system could encourage effective and stable economy. However it is needed to revise system`s administration, tax allowances, tax rates, and evaluate possible optimizations in order to reach best results. This could be a learning point to consider for Lithuania, due to open discussions of transferring proportional country`s tax system to progressive tax system. Both systems may reach economic and social improvements if implementation of system itself is reasonable. Case of Lithuania, would lead to suggestions to maintain current tax system, but focus on possible developments and changes within its operation.

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## ANNOTATION IN LITHUANIAN
## ANOTACIJA

Kniukštaitė A. *Progresinių gyventojų pajamų mokesčių įtaką fiskalinės, paskirstomosios ir reguliacinės mokesčių funkcijos efektyvumui Europos Sąjungoje/* Finansų rinkų magistro baigiamasis darbas. Vadovas asoc.prof.dr. Marius Lanskoronskis. – Vilnius, Mykolo Romerio Universitetas, Verslo ir medijų mokykla, 2016

Magistro baigiamajame darbe išanalizuota ir įvertinta progresinių gyventojų pajamų mokesčių įtaką fiskalinės, paskirstomosios ir reguliacinės mokesčių funkcijos efektyvumui. Pirmajame darbo skyriuje anlizuojama pateikta literatūros apžvalga apie progresinius mokesčius, jų kilmę, tikslus, naudą bei trūkumus, pajamų paskirstymo rodiklius ir jų pateikimo būdus. Antrojoje darbo dalyje pateiktas žvalgomojo pobūdžio tyrimas, analizuojantis pasirinktų šalių mokestines sistemas, tarifus bei pristatoma tyrimo metodologija. Sekančiame skyriuje analizuojama kiekvienos iš pasirinktų šalių mokestinė sistema, statistiniai jų rodikliai bei įgyvendintos reformos ar pokyčiai. Ketvirtojoje darbo dalyje vertinama progresinių gyventojų pajamų mokesčių įtaką fiskalinės, paskirstomosios ir reguliacinės mokesčių funkcijos efektyvumui pasirinktose šalyse, o penktoje darbo dalyje ši įtaka vertinama Europos Sąjungos lygmeniu. Darbo pabaigoje pateikiamos išvados bei rekomendacijos.

**Pagrindiniai žodžiai:** gyventojų pajamų mokestis, mokestinė sistema, progresinis gyventojų pajamų mokestis, fiskalinė, paskirstomoji ir reguliacinė mokesčių funkcijos

## ANNOTATION IN ENGLISH

Kniukštaitė A. *Impact of progressive personal income tax to efficiency of fiscal, redistributive, regulating tax functions in the European Union /* Financial markets master thesis. Supervisor assoc.prof.dr. Marius Lanskoronskis. – Vilnius, Mykolas Romeris University, Business Media School, 2016

This master thesis analysis and evaluates impact Impact of progressive personal income tax to efficiency of fiscal, redistributive, regulating tax functions in the European Union. First part of theses presents origin and conception of progressive tax, second part reviews tax systems within EU and presents methodology of tax functions` analysis. Third part of thesis analyses personal income tax systems, implemeted reforms, statistcal indictors of selected EU member states. Fouth part of thesis evaluates impact of progressive personal income tax on fiscal, redistributive, regulating tax functions within selected countries and final part of thesis

evaluates this impact within EU level. Based on results of analysis, conclusions and recommendations are provided at the end of this thesis.

**Keywords:** personal inocme tax, tax system, progressive personal income tax, fiscal, redistributive, regulating tax functions

## SUMMARY IN LITHUANIAN
## SANTRAUKA

Kniukštaitė A. *Progresinių gyventojų pajamų mokesčių įtaką fiskalinės, paskirstomosios ir reguliacinės mokesčių funkcijos efektyvumui Europos Sąjungoje/* Finansų rinkų magistro baigiamasis darbas. Vadovas asoc.prof.dr. Marius Lanskoronskis. – Vilnius, Mykolo Romerio Universitetas, Verslo ir medijų mokykla, 2016

Pagrindinis šio magistro darbo tikslas - įvertinti progresinių gyventojų pajamų mokesčių įtaką fiskalinės, paskirstomosios ir reguliacinės mokesčių funkcijos efektyvumui Europos Sąjungoje. Darbą sudaro penkios dalys, kuriose pateikiama literatūros apžvalga, žvalgomojo pobūdžio tyrimas, pristatoma tyrimo metodologija, analizuojama kiekvienos iš pasirinktų šalių mokestinė Sistema, vertinama progresinių gyventojų pajamų mokesčių įtaką fiskalinės, paskirstomosios ir reguliacinės mokesčių funkcijos efektyvumui pasirinktose šalyse ir bendru Europos Sąjungos lygmeniu.

Literatūros apžvalga aptaria progresinius mokesčius, jų kilmę, tikslus, naudą bei trūkumus, pajamų paskirstymo rodiklius ir jų pateikimo būdus. Toliau pereinama prie pasirinktų penkių Eurpos Sąjungos šalių: Prancūzijos, Belgijos, Danijos, Bulgarijos, Lietuvos analizės – šalyse galiojančios mokestinės sistemos bei susijusi statistika. Regresinės analizės pagalba, vertinamas progresinės sistemos efektyvumas, lyginimas su proporcine mokesčių sistema ir įtaka fiskalinės, paskirstomosios ir reguliacinės mokesčių funkcijos efektyvumui. Analizė toliau tęsiama Europos sąjungos lygmeniu. Analizuojama gyventojų pajamų mokesčio įtaka biudžeto deficitui, mokestinėms pajamoms ir nedarbo lygiui.

Analizės rezultatai rodo, jog gyventojų pajamų mokestis turi stiprią įtaką biudžeto deficitui – t.y. fiskalinei mokesčių funkcijai. Pastebima tendencija, kad progresiniai mokesčiai, lyginant su proporciniais, šiuo atveju yra efektyvesni. Paskirstomosios funkcijos analizė rodo, jog abi sistemos: tiek progresinė, tiek proporcinė - yra efektyvios šios funkcijos įgyvendinimui ir neturi ryškaus pranašumo lyginant viena su kita. Didesnių mokestinių pajamų užtikrinimui, gali būti naudojamos abi sistemos, nes pajamų didėjimą labiau lems kiti aspektai – pvz.: tarifai, mokestinės lengvatos, neamokestinamųjų pajamų dydis. Be to, tinkamų tarifų ir lengvatų nustatymas, gali užtikrinti ir galimai geresnį reguliacinės funkcijos įgyvendimimą nei progresivumo didinimas ar mažinimas. Pateiktos išvados ir rekomendacijos, apibendirina pagrindinius literatūros analizės aspektus, ir atlikto tyrimo rezultatus. Daroma prielaida, kad gauti rezultatai gali būti naudingi šalių vyriausybėms, ypač Lietuvos, kuri progresyvių mokesčių diskusijas, mokesčių reformos klausimą kelia ir

analizuoja jau ilgą laiką. Atliktas tyrimas, gali būti tęsiamas atliekant platesnę analizę: pasirenkant papildomas šalis bei kitus vertinimo indikatorius bei modelius.

## SUMMARY IN ENGLISH

Kniukštaitė A. *Impact of progressive personal income tax to efficiency of fiscal, redistributive, regulating tax functions in the European Union* / Financial markets master thesis. Supervisor assoc.prof.dr. Marius Lanskoronskis. – Vilnius, Mykolas Romeris University, Business Media School, 2016

The main objective of this master thesis, is to analyze and evaluate impact of progressive personal income tax to efficiency of fiscal, redistributive, regulating tax functions in the European Union. Master thesis is divided into five parts: the analysis of literature, exploratory research and methodology, the impact analysis its results, conclusions and recommendations on the country level as well as on the European Union level.

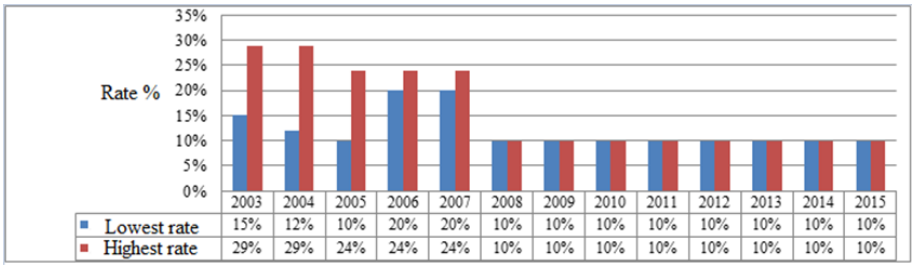
Literature analysis presents origin and conception of progressive tax, its advantages and disadvantages. Second part reviews tax systems within EU and presents methodology of tax functions` analysis. Third part of thesis analyses personal income tax systems, implemeted reforms, statistcal indictors of selected EU member states. Fouth part of thesis evaluates impact of progressive personal income tax on fiscal, redistributive, regulating tax functions within selected countries and final part of thesis evaluates this impact within EU level. The main purpose of the research (by analyzing impact of the personal income tax rate on country's budget deficit, revenue collected from personal income tax and unemployment.) was to evaluate if progressive taxes are more effective than proportional while implementing fiscal, redistributive, regulatory functions and improving economic and social conditions.

Results reveals that has a significant impact on the government deficit - fiscal tax function, and that there is a tendency that progressive taxes work more effectively than the proportional taxes in this case. The analysis of redistributive function indicates that both: progressive and proportional taxes are relevant for its effectiveness, and that, none of the systems is more effective than another. Both systems can be used to ensure higher level of tax revenue to budget, as tax allowances, tax rates, non-taxable income level will affect it either. Furthermore, proper selection of tax allowances, tax rates may even result in better implementation of regulatory function, than just by simply increasing or reducing progressivity. Main concepts of literature analysis and the results of the performed research are presented in summary and recommendations. Assumption is stated, that results of this

research may give useful and proper guidelines to the countries` that are considering changing or fully reforming its tax system. Such example may be Lithuania, as there have been many public discussions of tax system changes or progressive tax system implication probabilities. This research may be further continued, by selecting different additional countries or applying other models and indicators.

# Appendices

## Appendix 1. Personal income tax in Bulgaria 2003-20156



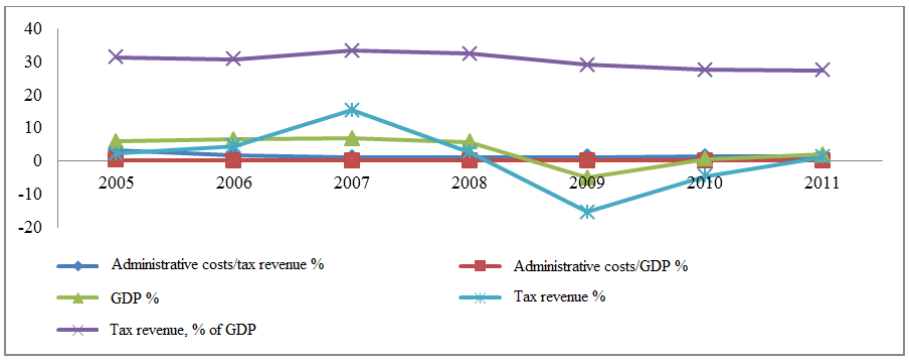

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest rate | 15% | 12% | 10% | 20% | 20% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| Highest rate | 29% | 29% | 24% | 24% | 24% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |

Data source:
(http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tec00115&language=en)

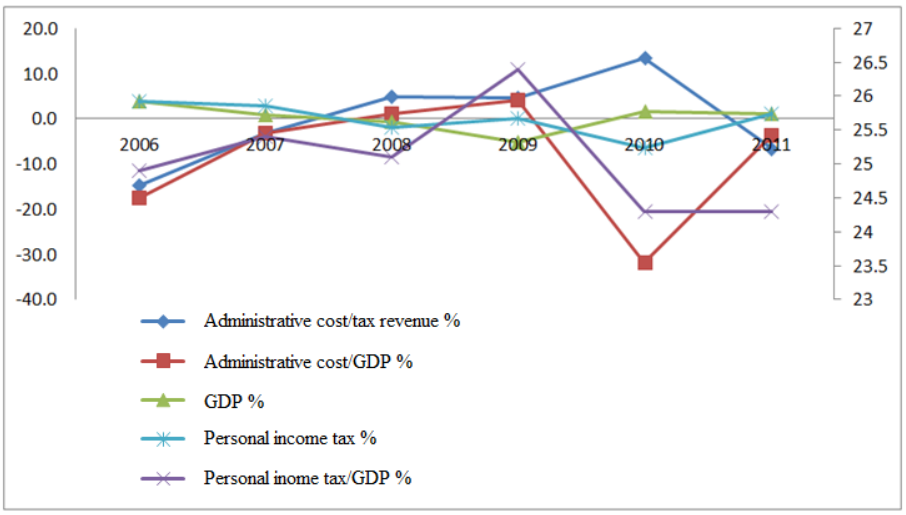
## Appendix 2.

Data source:
(http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tec00115&language=en)

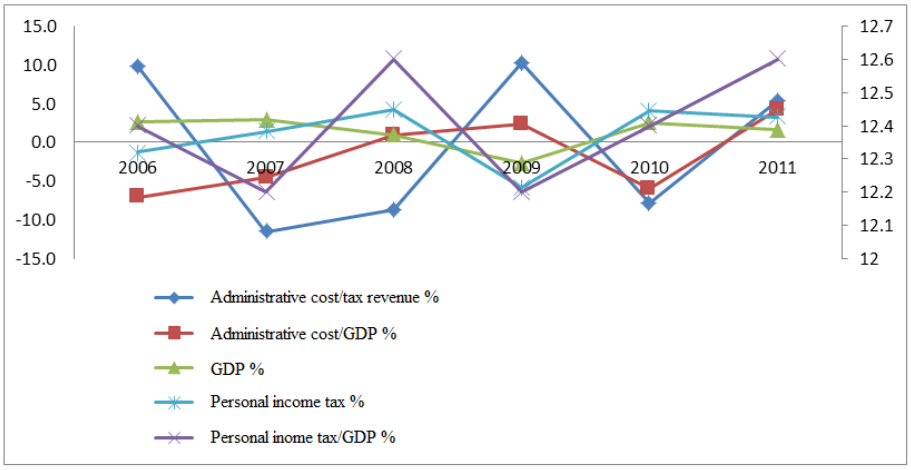
### 2.1. Administrative costs, tax revenue, GDP in Bulgaria 2005-2011



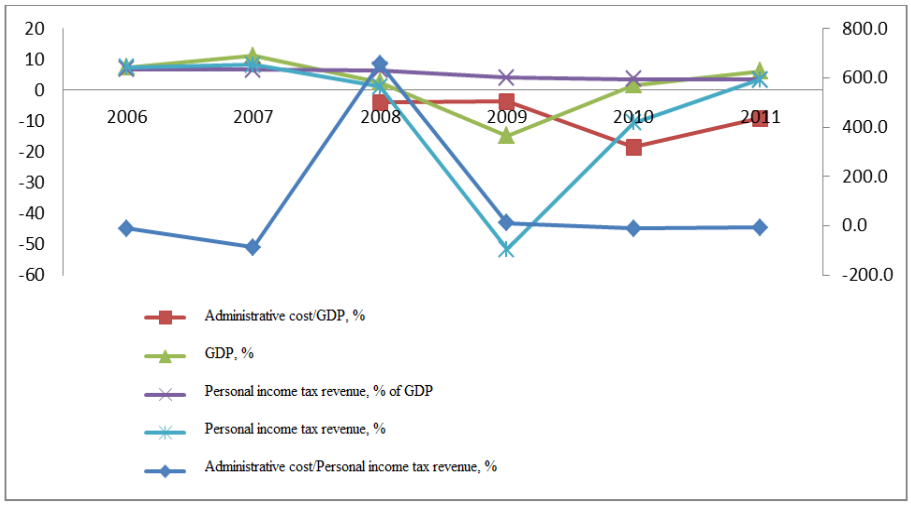

### 2.2. Administrative costs, tax revenue, GDP in Denmark 2006-2011



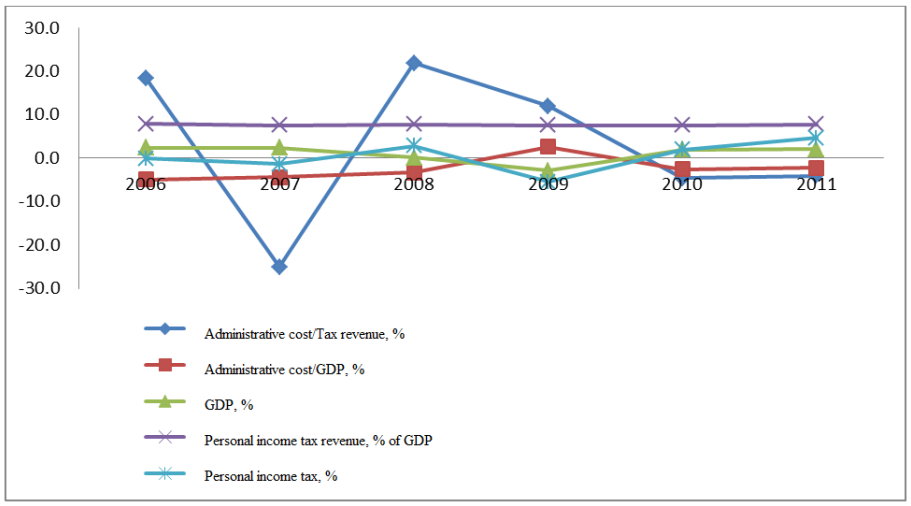

### 2.3. Administrative costs, tax revenue, GDP in Belgium 2006-2011



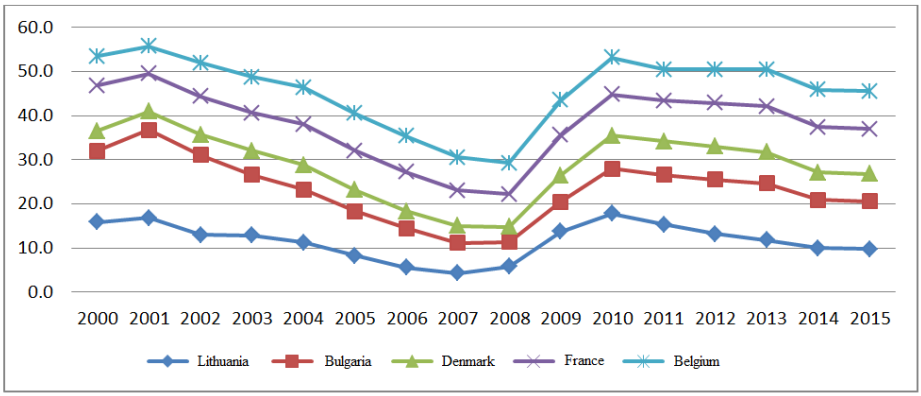

2.4. Administrative costs, tax revenue, GDP in Lithuania 2006-2011




2.5. Administrative costs, tax revenue, GDP in France 2006-2011




Appendix 3. Unemployment rate %, of total labor force (Lithuania, Bulgaria, Denmark, France, Belgium) 2000-2015



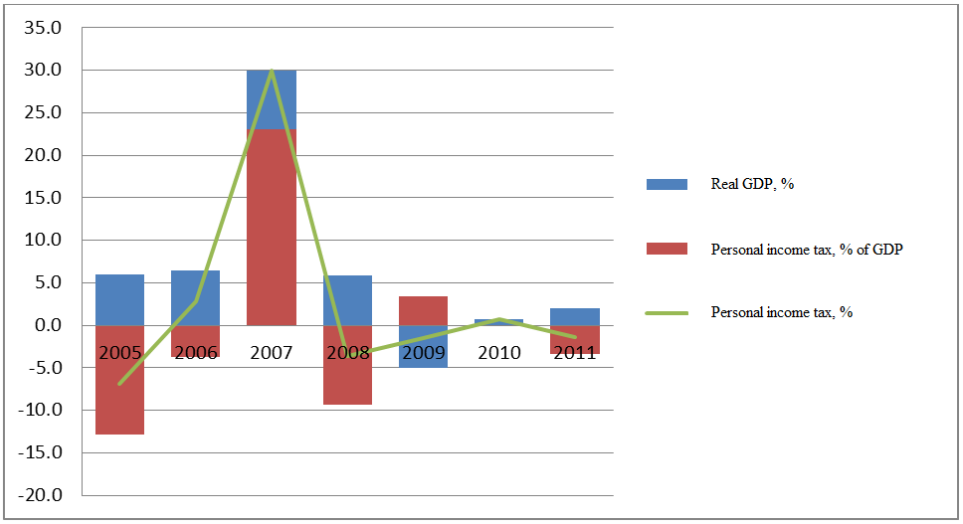

Data source:
(http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdec450&plugin=1)

Appendix 4. Composition of personal income tax in Bulgaria 2007-2013

| | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** |
|---|---|---|---|---|---|---|---|
| **Total personal income tax (mln. BGN)** | 1809 | 1972 | 2051 | 2031 | 2180 | 2298 | 2349 |
| *variation, %* | *n/a* | *8.9* | *3.8* | *-0.9* | *7.1* | *5.1* | *2.1* |
| from salary income, mln. BGN | 1403 | 1556 | 1688 | 1694 | 1769 | 1862 | 1866 |
| *variation, %* | *n/a* | *10.9* | *8.2* | *0.3* | *4.2* | *5.2* | *0.1* |
| from individual activities, mln. BGN | 304 | 305 | 251 | 217 | 274 | 288 | 263 |
| *variation, %* | *n/a* | *0.2* | *-17.5* | *-13.5* | *26.4* | *5.2* | *-8.6* |
| From licence, mln. BGN | 36 | 30 | 21 | 19 | 17 | 16 | 14 |
| variation, % | *n/a* | *-16.1* | *-29.2* | *-13.2* | *-8.1* | *-8.9* | *-7.4* |
| other income, that are taxable, mln. BGN | 66 | 80 | 92 | 102 | 121 | 132 | 205 |
| *variation, %* | *n/a* | *2.1* | *14.3* | *11.2* | *17.3* | *9.8* | *55.2* |

Data source:
(http://www.minfin.bg/en/page/175)

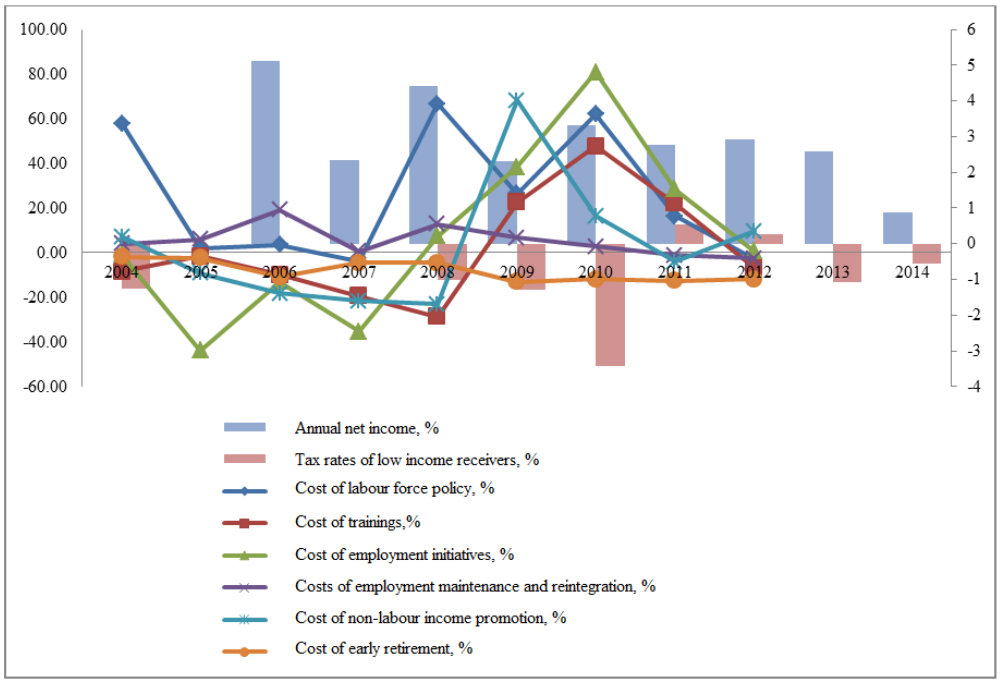
Appendix 5. Personal income tax and GDP changes 2005-2011 in Bulgaria




| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|
| GDP | | 5.9 | 6.4 | 6.8 | 5.9 | -4.9 | 0.6 | 1.9 |
| Tax revenue, % of GDP | 33 | 31 | 31 | 33 | 32 | 28 | 28 | 27 |
| Variance of Tax revenue within GDP, % | | -3.6 | -1.8 | 8.3 | -2.9 | -10.1 | -5.4 | -0.6 |
| Variance of tax revenue, % | | 2.2 | 4.3 | 15.2 | 2.8 | -15.1 | -4.3 | 1.2 |
| Personal income tax revenue, % of GDP | 3.3 | 2.5 | 2.4 | 3.1 | 2.7 | 2.9 | 2.8 | 2.8 |
| Variance of Personal income tax revenue, % of GDP | | -12.7 | -3.5 | 23.3 | -9.2 | 3.2 | 0.1 | -3.2 |
| Variance of Personal income tax, % | | -6.7 | 2.6 | 29.9 | -3.4 | -1.4 | 0.5 | -1.2 |

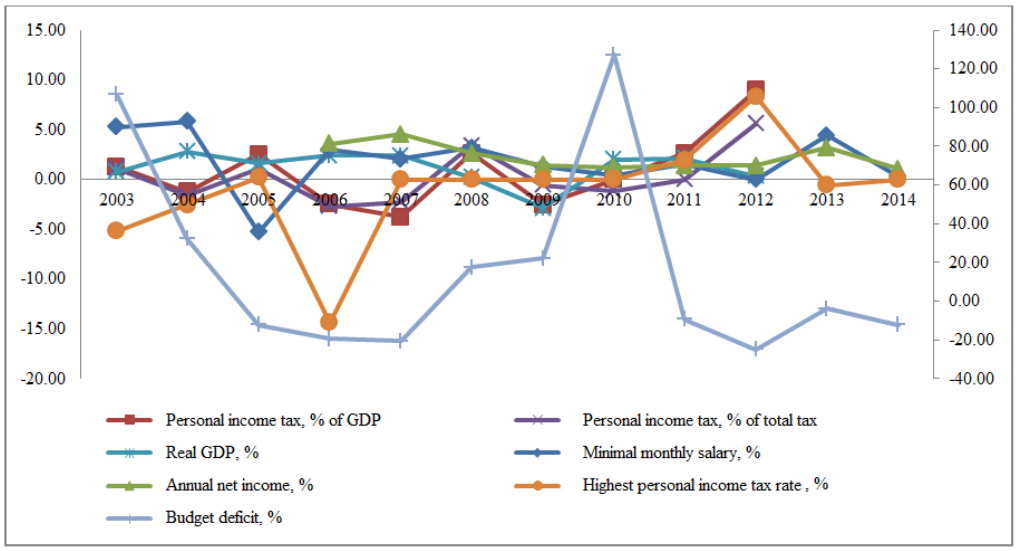
Data source:
(http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tec00115&language=en)

Appendix 6. Labor force policy costs, annual net salary and tax rates of low income receivers in Denmark 2004-2014



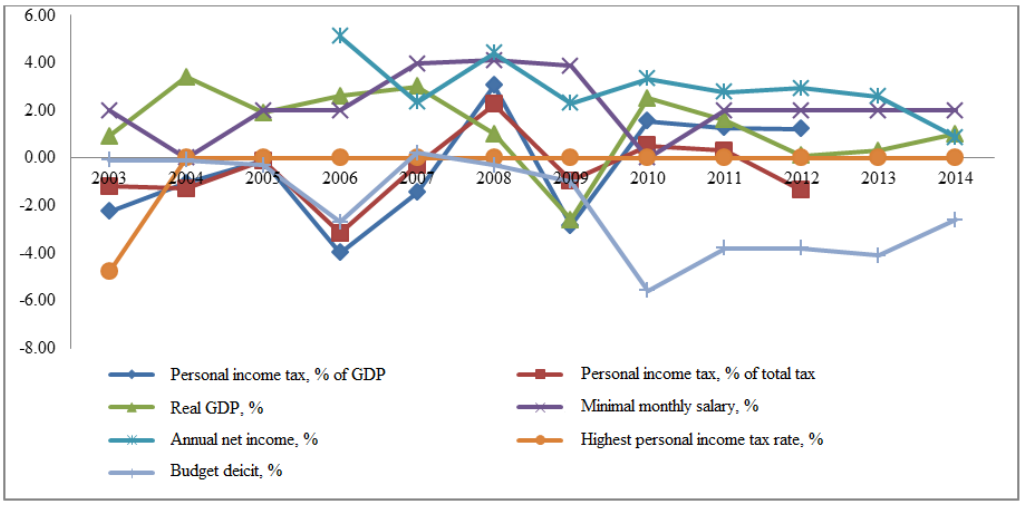

Data source: (http://ec.europa.eu/eurostat/data/database)

Appendix 7. Personal income tax of GDP, tax revenue, real GDP, minimal monthly salary, annual net income, highest personal income tax rate, budget deficit in France 2003-2014



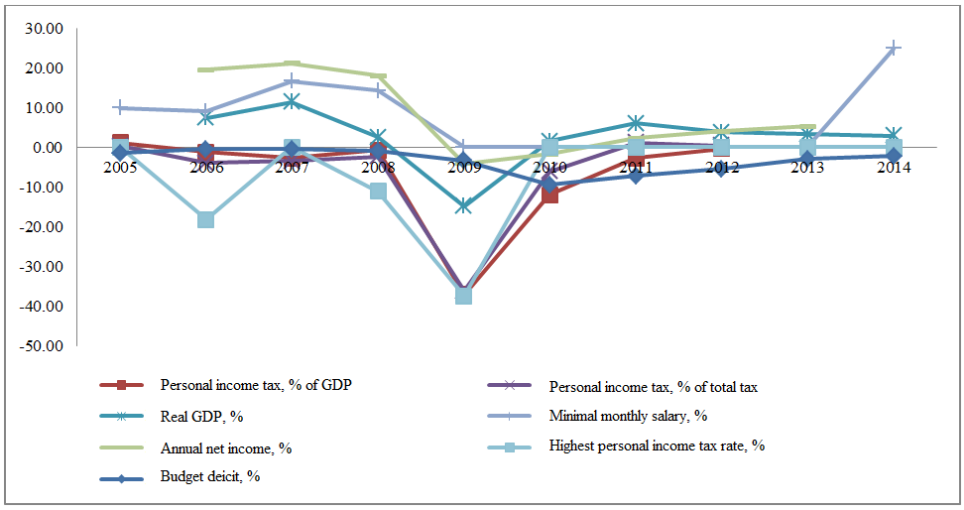

Data source: (http://ec.europa.eu/eurostat/data/database)

Appendix 8. Personal income tax of GDP, tax revenue, real GDP, minimal monthly salary, annual net income, highest personal income tax rate, budget deficit in Belgium 2003-2014




Data source: (http://ec.europa.eu/eurostat/data/database)

Appendix 9. Personal income tax of GDP, tax revenue, real GDP, minimal monthly salary, annual net income, highest personal income tax rate, budget deficit in 2005-2014




Data source: [(http://ec.europa.eu/eurostat/data/database)](http://ec.europa.eu/eurostat/data/database)

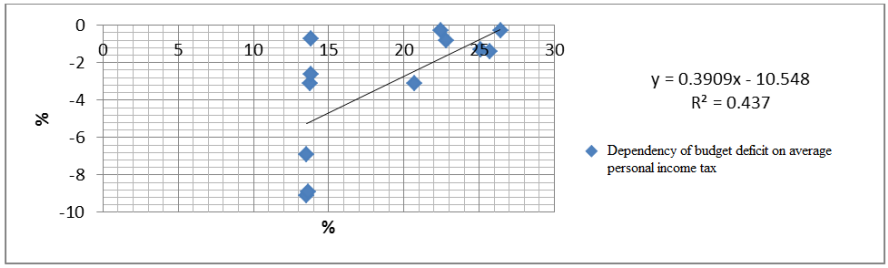
Appendix 10. Significance of personal income tax to fiscal tax function. Indicators of: Lithuania, Denmark, Belgium, Bulgaria, France. Graphical analysis, correlation coefficient, significance test of x indicator in regression equation.

1. Lithuania

1.1. Dependency of budget deficit on average personal income tax rate:

| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | y | -1.3 | -1.4 | -0.3 | -0.3 | -0.8 | -3.1 | -9.1 | -6.9 | -8.9 | -3.1 | -2.6 | -0.7 | -0.2 |
| Average personal income tax rate (on average salary) | $x_1$ | 25.06 | 25.68 | 26.39 | 22.46 | 22.78 | 20.67 | 13.52 | 13.51 | 13.64 | 13.76 | 13.81 | 13.83 | 13.84 |

Graphical analysis:




Correlation coefficient: 0,6610

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,661033731 |
| R Square | 0,436965617 |
| Adjusted R Square | 0,380662138 |
| Standard Error | 2,567152235 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 51,14646029 | 51,14645 | 7,760903 | 0,019252 |
| Residual | 11 | 65,90270644 | 6,590272 | | |
| Total | 12 | 117,0491666 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -10,54828440 | 2,736972712 | -3,853 | 0,003190 | -16,6467 | -4,44992 | -16,6467 | -4,44992 |
| $x_1$ | 0,390942802 | 0,14033212 | 2,78583 | 0,019256 | 0,078262 | 0,703621 | 0,078262 | 0,703621 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).

H1 - X1 statistically significant.

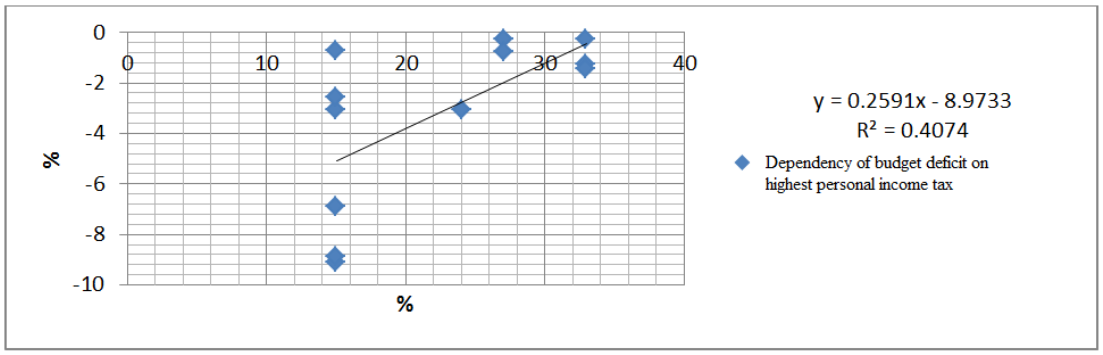
| | |
|---|---|
| t Stat | 2,786 |
| t Stat theoretical | 2,228 |

2,8>2,2

1.2. Dependency of budget deficit on highest personal income tax rate

| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | y | -1.3 | -1.4 | -0.3 | -0.3 | -0.8 | -3.1 | -9.1 | -6.9 | -8.9 | -3.1 | -2.6 | -0.7 | -0.2 |
| Highest personal income tax rate | $x_1$ | 33 | 33 | 33 | 27 | 27 | 24 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |

Graphical analysis:




Correlation coefficient: 0,6381

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,6382443 |
| R Square | 0,4073558 |
| Adjusted R Square | 0,3480914 |
| Standard Error | 2,6337897 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 47,6806766 | 47,6805 | 6,8735 | 0,025522 |
| Residual | 11 | 69,3684898 | 6,93683 | | |
| Total | 12 | 117,049165 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -8,9732840 | 2,32663549 | -3,85676 | 0,0031 | -14,1574 | -3,78922 | -14,1574 | -3,78922 |
| $x_1$ | 0,2590988 | 0,09882696 | 2,62173 | 0,0254 | 0,038898 | 0,479298 | 0,038898 | 0,479298 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).

H1 - X1 statistically significant

| | |
|---|---|
| t Stat | 2,621 |
| t Stat theoretical | 2,227 |

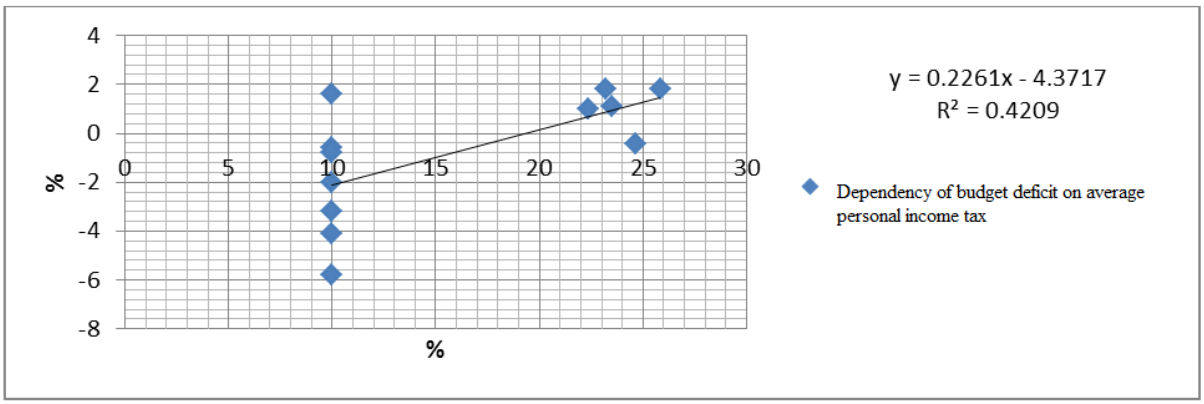
2,62>2,23

2. Bulgaria

2.1. Dependency of budget deficit on average personal income tax rate:

| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | y | -0.4 | 1.8 | 1 | 1.8 | 1.1 | 1.6 | -4.1 | -3.2 | -2 | -0.6 | -0.8 | -5.8 | -2.1 |
| Average personal income tax rate (on average salary) | $x_1$ | 24.63 | 25.84 | 22.31 | 23.21 | 23.49 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

Graphical analysis:




Correlation coefficient: 0,6487

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,648757 |
| R Square | 0,420888 |
| Adjusted R Square | 0,362975 |
| Standard Error | 2,005045 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 29,21797 | 29,2178 | 7,26778 | 0,022471 |
| Residual | 11 | 40,20201 | 4,02021 | | |
| Total | 12 | 69,43 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -4,37165 | 1,445775 | -3,0236 | 0,012812 | -7,59305 | -1,15027 | -7,59305 | -1,15027 |
| $x_1$ | 0,226137 | 0,083882 | 2,6956 | 0,022471 | 0,039235 | 0,413042 | 0,039235 | 0,41304 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).
H1 - X1 statistically significant.

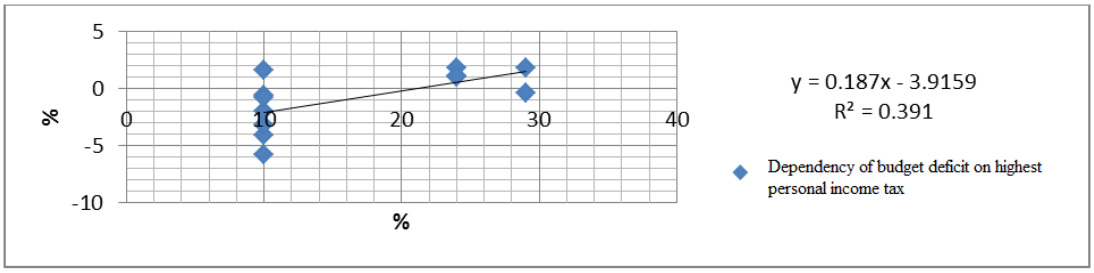
| | |
|---|---|
| t Stat | 2,71 |
| t Stat theoretical | 2,228 |

2,71>2,23

2.2 Dependency of budget deficit on highest personal income tax rate

| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | y | -0.4 | 1.8 | 1 | 1.8 | 1.1 | 1.6 | -4.1 | -3.2 | -2 | -0.6 | -0.8 | -5.8 | -2.1 |
| Highest personal income tax rate | $x_1$ | 29 | 29 | 24 | 24 | 24 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

Graphical analysis:




Correlation coefficient: 0,6253

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,625326 |
| R Square | 0,391032 |
| Adjusted R Square | 0,330136 |
| Standard Error | 2,056074 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 27,1454 | 27,14554 | 6,42125 | 0,029665 |
| Residual | 11 | 42,2733 | 4,227444 | | |
| Total | 12 | 69,43 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -3,91587 | 1,36536 | -2,86798 | 0,01673 | -6,95814 | -0,87364 | -6,95814 | -0,87364 |
| $x_1$ | 0,186952 | 0,07376 | 2,534022 | 0,02965 | 0,022566 | 0,351337 | 0,022566 | 0,351337 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).
H1 - X1 statistically significant.

| | |
|---|---|
| t Stat | 2,533 |
| t Stat theoretical | 2,227 |

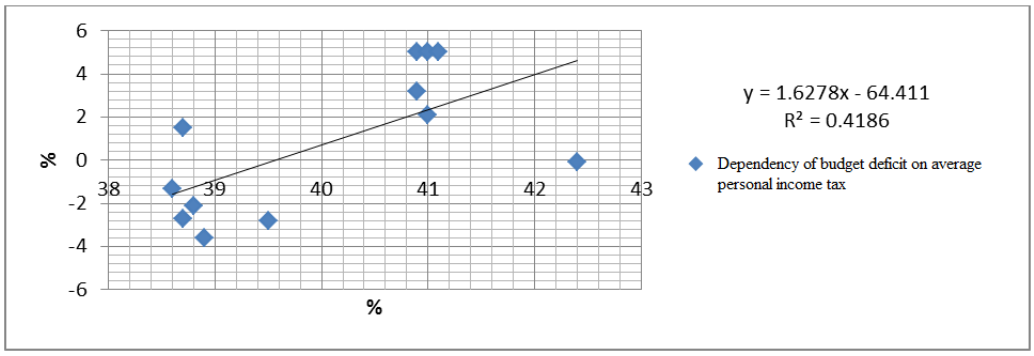
2,53>2,23

3. Denmark

3.1. Dependency of budget deficit on average personal income tax rate:

| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | **y** | -0,1 | 2,1 | 5 | 5 | 5 | 3,2 | -2,8 | -2,7 | -2,1 | -3,6 | -1,3 | 1,5 | -2,1 |
| Average personal income tax rate (on average salary) | **$x_1$** | 42,4 | 41 | 40,9 | 41 | 41,1 | 40,9 | 39,5 | 38,7 | 38,8 | 38,9 | 38,6 | 38,7 | 38,6 |

Graphical analysis:




Correlation coefficient: 0,6470

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,647014 |
| R Square | 0,418628 |
| Adjusted R Square | 0,360491 |
| Standard Error | 2,630784 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 49,83633 | 49,83634 | 7,20072 | 0,022957 |
| Residual | 11 | 69,21032 | 6,921033 | | |
| Total | 12 | 119,0466 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -64,4112 | 24,30104 | -2,65053 | 0,02428 | -118,555 | -10,264 | -118,555 | -10,2654 |
| $x_1$ | 1,627751 | 0,606597 | 2,683413 | 0,02294 | 0,276168 | 2,97932 | 0,276168 | 2,979332 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).
H1 - X1 statistically significant.

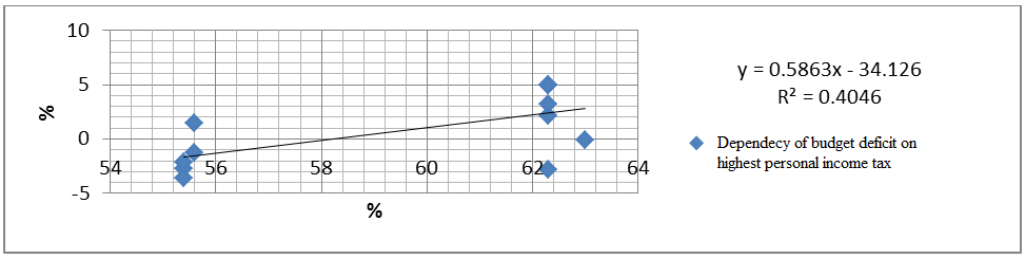
| | |
|---|---|
| t Stat | 2,683 |
| t Stat theoretical | 2,227 |

2,683>2,23

3.2. Dependency of budget deficit on highest personal income tax rate:

| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | **y** | -0,1 | 2,1 | 5 | 5 | 5 | 3,2 | -2,8 | -2,7 | -2,1 | -3,6 | -1,3 | 1,5 | -2,1 |
| Highest personal income tax | $x_1$ | 63 | 62,3 | 62,3 | 62,3 | 62,3 | 62,3 | 62,3 | 55,4 | 55,4 | 55,4 | 55,6 | 55,6 | 55,8 |

Graphical analysis:




Correlation coefficient: 0,6360

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,636074 |
| R Square | 0,404592 |
| Adjusted R Square | 0,34504 |
| Standard Error | 2,662355 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 48,1653 | 48,16524 | 6,79517 | 0,026188 |
| Residual | 11 | 70,8813 | 7,088142 | | |
| Total | 12 | 119,045 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -34,1255 | 13,4072 | -2,54528 | 0,02908 | -63,9992 | -4,25214 | -63,9992 | -4,25214 |
| $x_1$ | 0,586262 | 0,2248 | 2,606757 | 0,02617 | 0,085153 | 1,08736 | 0,085153 | 1,08736 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).

H1 - X1 statistically significant

| | |
|---|---|
| t Stat | 2,606 |
| t Stat theoretical | 2,227 |

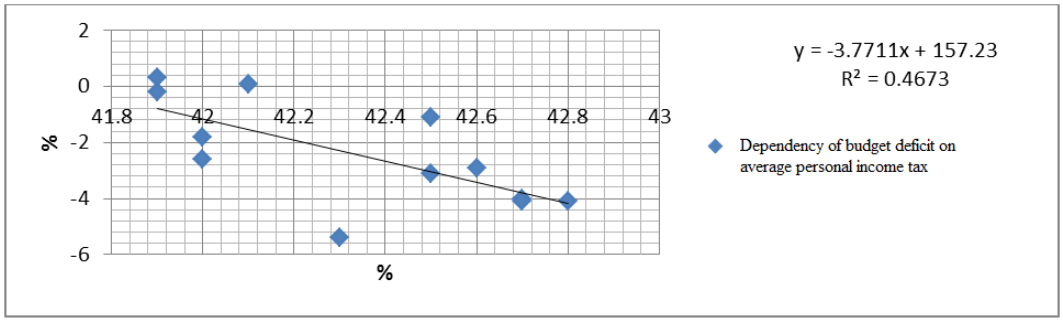
2,61>2,23

4. Belgium

4.1. Dependency of budget deficit on average personal income tax rate:

| | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | **y** | -1,8 | -0,2 | -2,6 | 0,3 | 0,1 | -1,1 | -5,4 | -4 | -4,1 | -4,1 | -2,9 | -3,1 | -2,6 |
| Average personal income tax rate (on average salary) | **$x_1$** | 42 | 41,9 | 42 | 41,9 | 42,1 | 42,5 | 42,3 | 42,7 | 42,8 | 42,7 | 42,6 | 42,5 | 42,3 |

Graphical analysis:




Correlation coefficient: 0,6835

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,683574 |
| R Square | 0,467274 |
| Adjusted R Square | 0,414001 |
| Standard Error | 1,433043 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 18,0131 | 18,01305 | 8,77143 | 0,014247 |
| Residual | 11 | 20,5362 | 2,053612 | | |
| Total | 12 | 38,5492 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 157,2319 | 53,9038 | 2,916881 | 0,01527 | 37,12669 | 277,3389 | 37,12669 | 277,3389 |
| $x_1$ | -3,77112 | 1,27319 | -2,96159 | 0,01419 | -6,60827 | -0,93389 | -6,60827 | -0,93389 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).

H1 - X1 statistically significant.

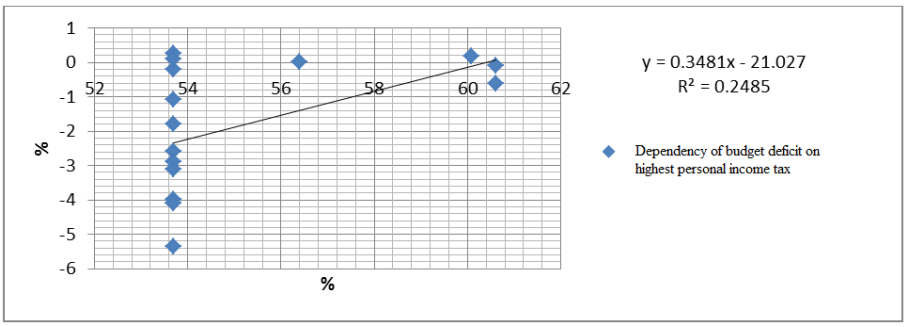
| | |
|---|---|
| t Stat | 2,962 |
| t Stat theoretical | 2,228 |

2,96>2,23

4.2 Dependency of budget deficit on highest personal income tax rate:

| | | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | y | -0,6 | -0,1 | 0,2 | 0 | -1,8 | -0,2 | -2,6 | 0,3 | 0,1 | -1,1 | -5,4 | -4 | -4,1 | -4,1 | -2,9 | -3,1 | -2,6 |
| Highest personal income tax | $x_1$ | 60,6 | 60,6 | 60,1 | 56,4 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,8 | 53.7 |

Graphical analysis:




Correlation coefficient: 0,4984

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,498465 |
| R Square | 0,248468 |
| Adjusted R Square | 0,194787 |
| Standard Error | 1,702143 |
| Observations | 17 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 13,41048 | 13,41048 | 4,628633 | 0,049386 |
| Residual | 15 | 40,56202 | 2,897287 | | |
| Total | 16 | 53,9725 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -21,0267 | 8,929447 | -2,35476 | 0,033657 | -40,1785 | -1,87496 | -40,1785 | -1,87496 |
| $x_1$ | 0,348064 | 0,161783 | 2,151426 | 0,049386 | 0,001074 | 0,695054 | 0,001074 | 0,695054 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).

H1 - X1 statistically significant.

| | |
|---|---|
| t Stat | 2,152 |
| t Stat theoretical | 2,144 |

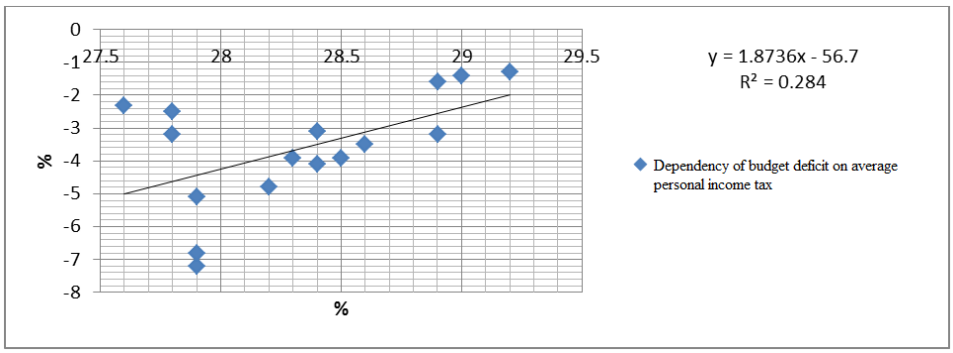
2,152>2,144

5. France

5.1. Dependency of budget deficit on average personal income tax rate:

| | | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | y | -1,6 | -1,3 | -1,4 | -3,1 | -3,9 | -3,5 | -3,2 | -2,3 | -2,5 | -3,2 | -7,2 | -6,8 | -5,1 | -4,8 | -4,1 | -3,9 | -3,5 |
| Average personal income tax rate (on average salary) | $x_1$ | 28,9 | 29,2 | 29 | 28,4 | 28,5 | 28,6 | 28,9 | 27,6 | 27,8 | 27,8 | 27,9 | 27,9 | 27,9 | 28,2 | 28,4 | 28,3 | 28,2 |

Graphical analysis:




Correlation coefficient: 0,5329

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,532906 |
| R Square | 0,28398 |
| Adjusted R Square | 0,23284 |
| Standard Error | 1,515783 |
| Observations | 17 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 12,75805 | 12,75805 | 5,552789 | 0,033538 |
| Residual | 15 | 32,16632 | 2,297592 | | |
| Total | 16 | 44,92437 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -56,7002 | 22,52935 | -2,51674 | 0,024655 | -105,022 | -8,37957 | -105,022 | -8,37957 |
| $x_1$ | 1,873602 | 0,7953 | 2,356436 | 0,033548 | 0,168281 | 3,578922 | 0,168281 | 3,578922 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).

H1 - X1 statistically significant.

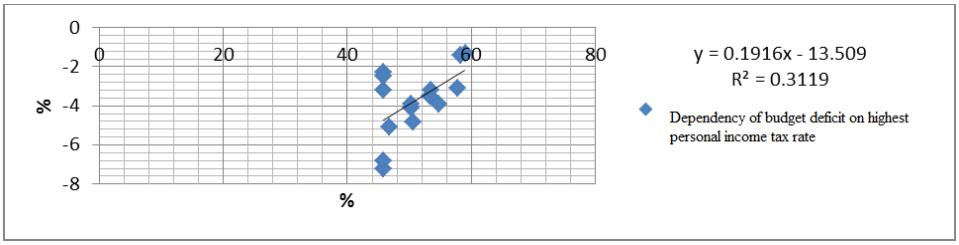
| | |
|---|---|
| t Stat | 2,355 |
| t Stat theoretical | 2,146 |

2,355>2,146

4.2 Dependency of budget deficit on highest personal income tax rate:

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget deficit, % of GDP | y | -1,3 | -1,4 | -3,1 | -3,9 | -3,5 | -3,2 | -2,3 | -2,5 | -3,2 | -7,2 | -6,8 | -5,1 | -4,8 | -4,1 | -3,9 | -3,5 |
| Highest personal income tax | $x_1$ | 59 | 58,3 | 57,8 | 54,8 | 53,4 | 53,5 | 45,8 | 45,8 | 45,8 | 45,8 | 45,8 | 46,7 | 50,6 | 50,3 | 50,3 | 50,2 |

Graphical analysis:




Correlation coefficient: 0,5584

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,558492 |
| R Square | 0,311914 |
| Adjusted R Square | 0,258982 |
| Standard Error | 1,46553 |
| Observations | 16 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 12,65656 | 12,65657 | 5,89293 | 0,030472 |
| Residual | 14 | 27,92073 | 2,14773 | | |
| Total | 15 | 40,57734 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -13,5093 | 4,036648 | -3,34665 | 0,005255 | -22,22 | -4,78865 | -22,22 | -4,78865 |
| $x_1$ | 0,191618 | 0,078935 | 2,42753 | 0,030472 | 0,021088 | 0,362148 | 0,021088 | 0,362148 |

Significance of X:

H0 - X1 not statistically significant (95% probability- accepted).

H1 - X1 statistically significant.

| | |
|---|---|
| t Stat | 2,427 |
| t Stat theoretical | 2,163 |

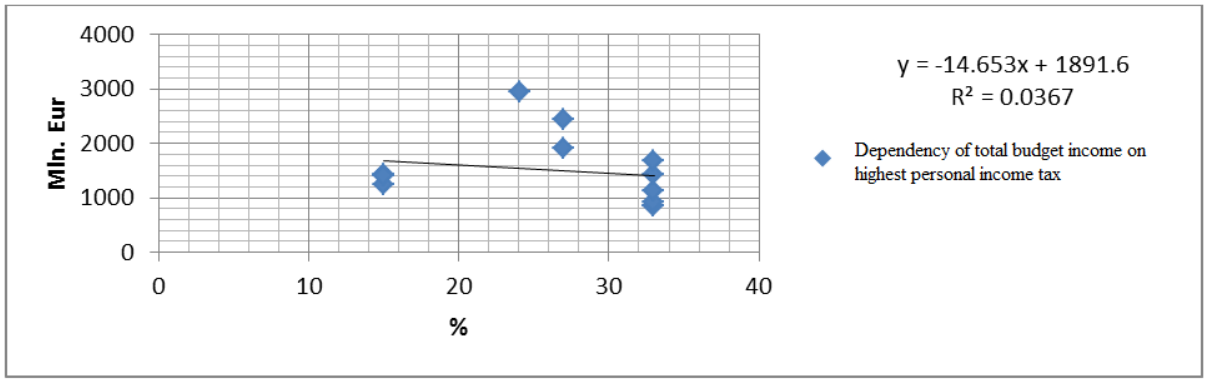
2,427>2,163

Appendix 11. Significance of personal income tax to redistributive tax function. Indicators of: Lithuania, Denmark, Belgium, Bulgaria, France. Graphical analysis, correlation coefficient, significance test of x indicator in regression equation.

1. Personal income tax within total budget income in Lithuania:

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget, mln. EUR | y | 826.3 | 827.5 | 911.4 | 1144.4 | 1445.7 | 1684.5 | 1928.3 | 2441.2 | 2924.7 | 1439.4 | 1256.2 | 1435.3 | 1406.4 |
| Highest personal income tax, % | $x_1$ | 33 | 33 | 33 | 33 | 33 | 33 | 27 | 27 | 24 | 15 | 15 | 15 | 15 |

Graphical analysis:




Correlation coefficient: -0,1914

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,191495 |

| | |
|---|---|
| R Square | 0,036672 |
| Adjusted R Square | -0,0508 |
| Standard Error | 633,922 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 168272 | 168272 | 0,418734 | 0,530842 |
| Residual | 11 | 4420413 | 401855,7 | | |
| Total | 12 | 4588684 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 1891,556 | 611,1104 | 3,095277 | 0,01018 | 546,5117 | 3236,601 | 546,5117 | 3236,601 |
| X Variable 1 | -14,6533 | 22,64447 | -0,6472 | 0,530842 | -64,4932 | 35,18697 | -64,4932 | 35,18697 |

Significance of X:

H0 - X1 not statistically significant (95% probability – not rejected).

H1 - X1 statistically significant.

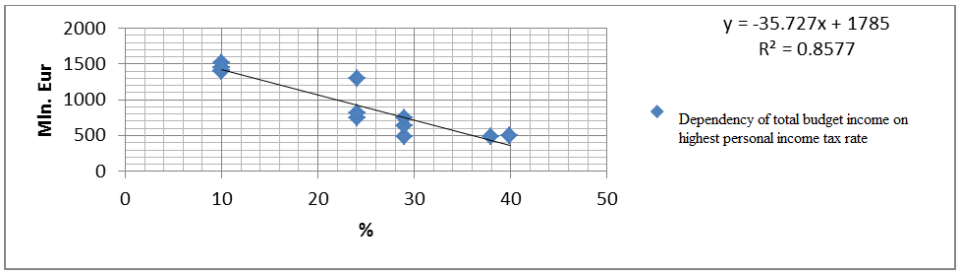
| | |
|---|---|
| t Stat | -0,6473 |
| t Stat theoretical | 2,202 |

-0,647<2,202

2. Personal income tax within total budget income in Bulgaria:

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget, mln. EUR | y | 506.6 | 474.4 | 490.3 | 628.1 | 757.2 | 750.5 | 815.2 | 1307.4 | 1453.3 | 1403.1 | 1380.8 | 1524.1 | 1465.2 |
| Highest personal income tax, % | $x_1$ | 40 | 38 | 29 | 29 | 29 | 24 | 24 | 24 | 10 | 10 | 10 | 10 | 10 |

Graphical analysis:




Correlation coefficient: -0,9262

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,926162 |

| | |
|---|---|
| R Square | 0,857735 |
| Adjusted R Square | 0,844804 |
| Standard Error | 167,5685 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 1862244 | 1862244 | 66,32127 | 5,52E-06 |
| Residual | 11 | 308870,3 | 28079,14 | | |
| Total | 12 | 2171115 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 1785,043 | 107,426 | 16,6163 | 3,85E-09 | 1548,5 | 2021,488 | 1548,5 | 2021,488 |
| X Variable 1 | -35,7274 | 4,38707 | -8,14378 | 5,52E-06 | -45,3833 | -26,0715 | -45,3833 | -26,0715 |

Significance of X:

H0 - X1 not statistically significant (95% probability – not rejected).

H1 - X1 statistically significant.

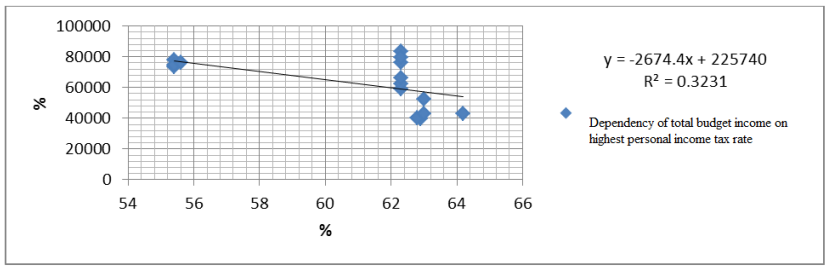
| | |
|---|---|
| t Stat | -8,1437 |
| t Stat theoretical | 2,203 |

8,144<2,203

3. Personal income tax within total budget income in Denmark:

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget, mln. EUR | y | 39654.4 | 40375.5 | 43241.2 | 52574.1 | 59123.3 | 62178.2 | 66347.5 | 76420.4 | 83553.2 | 79586.4 | 73282.1 | 78211.8 | 74442.3 | 76154.2 |
| Highest personal income tax, % | $x_1$ | 62,9 | 62,8 | 63 | 63 | 62,3 | 62,3 | 62,3 | 62,3 | 62,3 | 62,3 | 55,4 | 55,4 | 55,4 | 55,6 |

Graphical analysis:




Correlation coefficient: 0,5684

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,568463 |
| R Square | 0,323147 |

| | |
|---|---|
| Adjusted R Square | 0,271083 |
| Standard Error | 13478,62 |
| Observations | 15 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 1,12E+09 | 1,12E+09 | 6,206552 | 0,027028 |
| Residual | 13 | 2,35E+09 | 1,81E+08 | | |
| Total | 14 | 3,48E+09 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 225740,1 | 65324,47 | 3,455674 | 0,004262 | 84615,22 | 366865,3 | 84615,22 | 366865,3 |
| Top | -2674,34 | 1073,478 | -2,49128 | 0,027028 | -4993,45 | -355,241 | -4993,45 | -355,241 |

Significance of X:

H0 - X1 not statistically significant (95% probability – not rejected).

H1 - X1 statistically significant

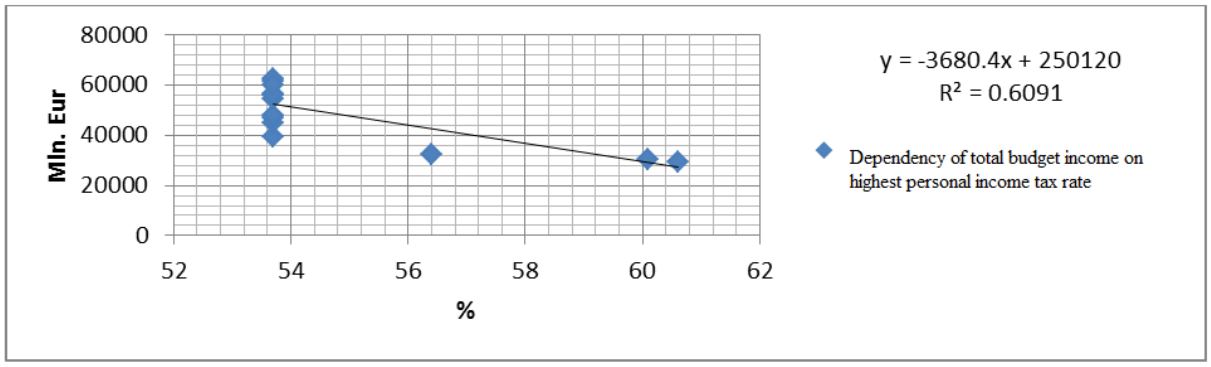
| | |
|---|---|
| t Stat | -2,492 |
| t Stat theoretical | 2,163 |

2,492<2,163

4. Personal income tax within total budget income in Belgium:

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget, mln. EUR | y | 29655.3 | 30367.5 | 32570.7 | 39248.1 | 45153.3 | 47106.3 | 47995.8 | 54392.6 | 61719.4 | 56004.7 | 56704.3 | 62617.5 | 59848.3 |
| Highest personal income tax, % | $x_1$ | 60,6 | 60,1 | 56,4 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 | 53,7 |

Graphical analysis:




Correlation coefficient: 0,7803

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,780318 |
| R Square | 0,609053 |
| Adjusted R Square | 0,573514 |
| Standard Error | 7759,221 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 1,02E+09 | 1,2E+09 | 17,1366 | 0,001644 |
| Residual | 11 | 6,63E+08 | 60205548 | | |
| Total | 12 | 1,68E+09 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 250120,4 | 48884,33 | 5,116576 | 0,00032 | 142526,7 | 357714,1 | 142526 | 357714,1 |
| X Variable 1 | -3680,43 | 889,0636 | -4,13965 | 0,00163 | -5637,23 | -1723,5 | -5637,23 | -1723,5 |

Significance of X:

H0 - X1 not statistically significant (95% probability – not rejected).

H1 - X1 statistically significant

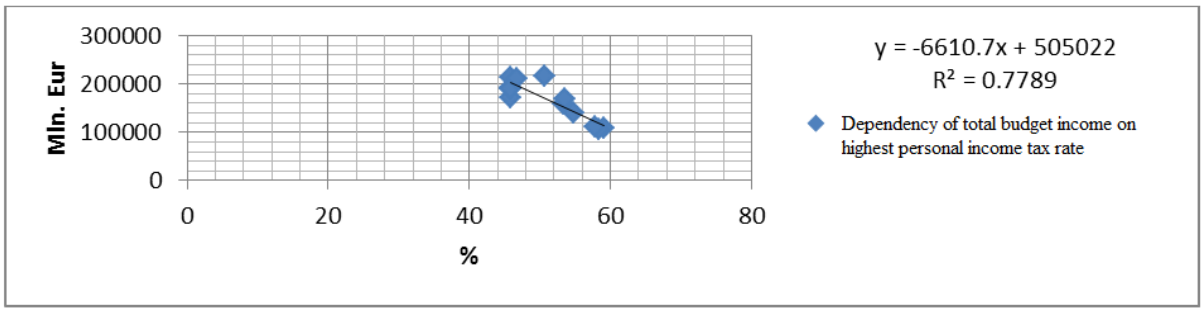
| | |
|---|---|
| t Stat | -4,1389 |
| t Stat theoretical | 2,203 |

4,138<2,203

5. Personal income tax within total budget income in France:

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget, mln. EUR | y | 108442.3 | 106926.4 | 111818.8 | 139481.4 | 158313.6 | 168390.8 | 173270.7 | 190930.2 | 215131.1 | 193131.5 | 210650.6 | 215445.4 |
| Highest personal income tax, % | $x_1$ | 59 | 58,3 | 57,8 | 54,8 | 53,4 | 53,5 | 45,8 | 45,8 | 45,8 | 45,8 | 46,7 | 50,6 |

Graphical analysis:




Correlation coefficient: -0,8825

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,882557 |
| R Square | 0,778908 |
| Adjusted R Square | 0,75882 |
| Standard Error | 19690,94 |
| Observations | 13 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 1,4E+10 | 1,4E+10 | 38,75332 | 6,47E-05 |
| Residual | 11 | 4,26E+09 | 3,87E+08 | | |
| Total | 12 | 1,92E+10 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 505021,4 | 54441,13 | 9,276468 | 1,55E-06 | 385197,3 | 624845,6 | 385197,3 | 624845,6 |
| X Variable 1 | -6610,73 | 1061,927 | -6,22521 | 6,47E-05 | -8948,01 | -4273,44 | -8948,01 | -4273,44 |

Significance of X:

H0 - X1 not statistically significant (95% probability – not rejected).

H1 - X1 statistically significant.

| | |
|---|---|
| t Stat | -6,2251 |
| t Stat theoretical | 2,202 |

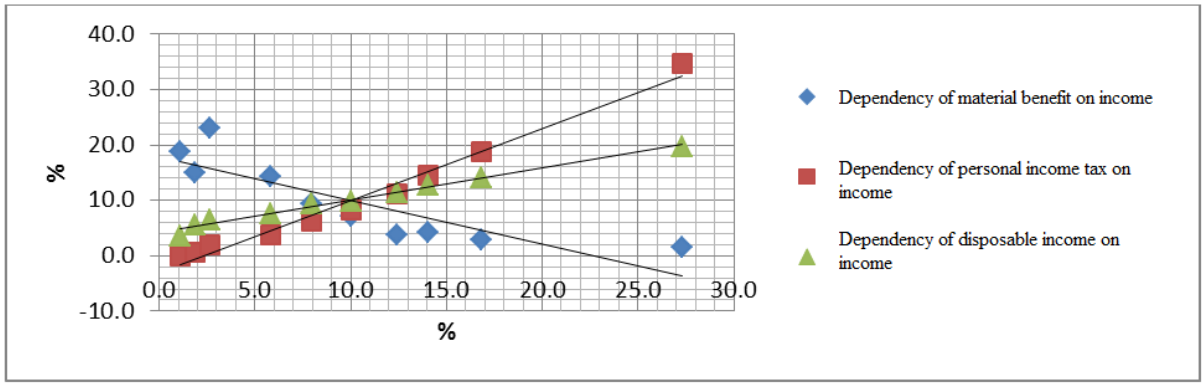
-6,223<2,202

Appendix 12. Significance of personal income tax to regulatory function. Data of France, Lithuania, Bulgaria, Denmark, Belgium in 2013. Graphical analysis, correlation coefficient, significance test of x indicator in regression equation.

1. Belgium

| **Decile group** | Income, % of total income | Material benefit, % of total benefit | Personal income tax, % of total personal income tax | Disposable income, % of total disposable income | Income, EUR | Material benefit, EUR | Personal income tax EUR | Disposable income, EUR |
|---|---|---|---|---|---|---|---|---|
| **1** | 1,1 | 18,6 | 0,1 | 3,7 | 514,7 | 197,5 | 1,8 | 1.063,2 |
| **2** | 1,8 | 14,9 | 0,6 | 5,4 | 884,5 | 157,6 | 53,8 | 1.602,2 |
| **3** | 2,5 | 22,9 | 1,8 | 6,5 | 1.232,6 | 241,7 | 159,7 | 1.869,3 |
| **4** | 5,7 | 14,2 | 3,6 | 7,4 | 2.713,5 | 150,1 | 302,7 | 2.203,5 |
| **5** | 7,8 | 9,3 | 6,2 | 9,4 | 3.707,7 | 98,3 | 517,6 | 2.746,2 |
| **6** | 9,9 | 7,1 | 8,3 | 9,7 | 4.669,5 | 75,5 | 672,9 | 2.884,8 |
| **7** | 12,3 | 3,8 | 11,1 | 11,6 | 5.788,4 | 39,4 | 916,4 | 3.368,4 |
| **8** | 13,9 | 4,2 | 14,3 | 12,6 | 6.554,8 | 43,2 | 1.182,4 | 3.716,4 |
| **9** | 16,7 | 2,7 | 18,9 | 14,1 | 7.846,1 | 29,8 | 1.537,2 | 4.115,1 |
| **10** | 27,2 | 1,4 | 34,6 | 19,7 | 12.749,2 | 16,2 | 2.842,6 | 5.804,7 |
| **Total:** | 100,0 | 100,0 | 100,0 | 100,0 | 46.661,0 | 1.049,0 | 8.187,2 | 29.373,8 |

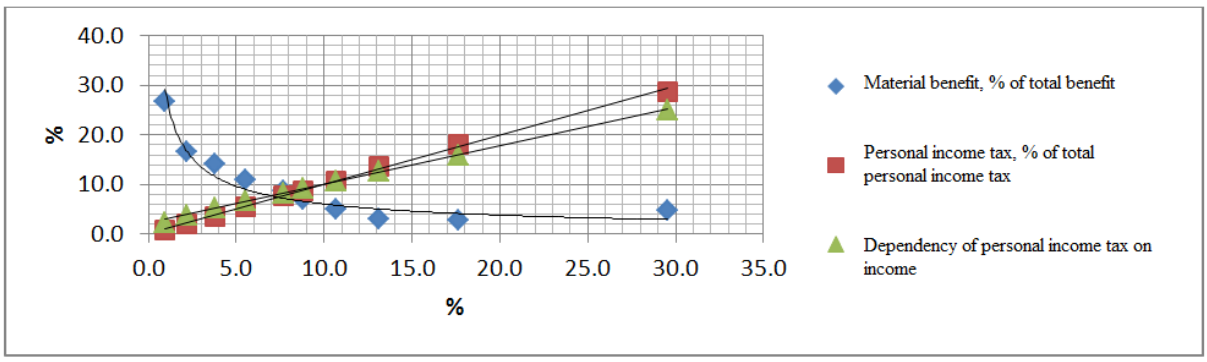
Graphical analysis:




2. Bulgaria

| **Decile group** | Income, % of total income | Material benefit, % of total benefit | Personal income tax, % of total personal income tax | Disposable income, % of total disposable income | Income, EUR | Material benefit, EUR | Personal income tax EUR | Disposable income, EUR |
|---|---|---|---|---|---|---|---|---|
| **1** | 1,1 | 26,6 | 1,1 | 2,4 | 58,7 | 26,8 | 5,1 | 164,8 |
| **2** | 2,3 | 16,7 | 2,2 | 3,7 | 133,5 | 16,5 | 10,4 | 255,1 |
| **3** | 3,7 | 14,2 | 3,4 | 5,5 | 233,8 | 14,3 | 17,8 | 359,1 |
| **4** | 5,4 | 10,8 | 5,5 | 6,6 | 338,8 | 10,8 | 28,6 | 446,6 |
| **5** | 7,8 | 8,8 | 7,9 | 8,3 | 473,3 | 8,8 | 39,6 | 544,2 |
| **6** | 8,7 | 7,1 | 8,7 | 9,2 | 538,2 | 7,1 | 44,7 | 608,7 |
| **7** | 10,6 | 5,3 | 10,9 | 10,6 | 657,5 | 5,1 | 54,8 | 714,3 |
| **8** | 13,2 | 3,0 | 13,5 | 12,5 | 807,1 | 3,2 | 69,3 | 841,8 |
| **9** | 17,5 | 2,9 | 18,2 | 15,9 | 1.083,1 | 2,7 | 92,2 | 1.052,8 |
| **10** | 29,7 | 4,6 | 28,7 | 25,2 | 1.814,8 | 4,8 | 146,8 | 1.667,6 |
| **Total:** | 100,0 | 100,0 | 100,0 | 100,0 | 6.138,5 | 100,0 | 509,3 | 6.655,1 |

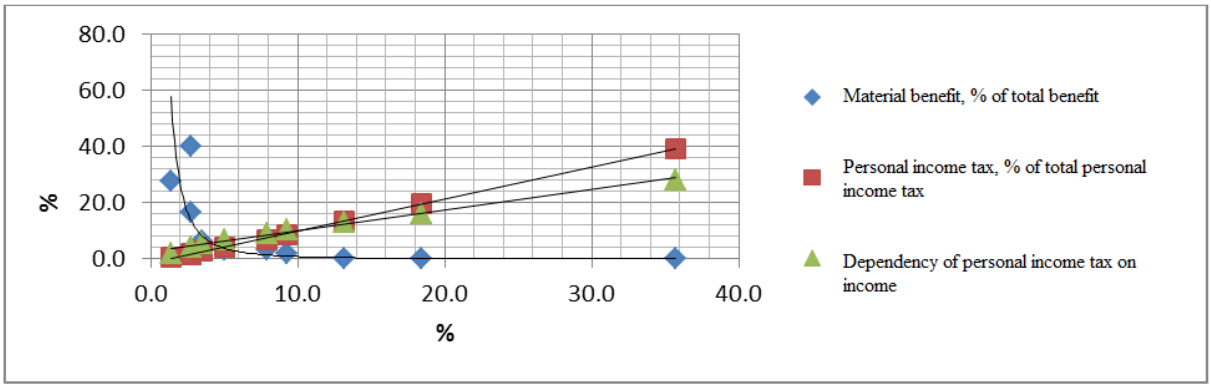
Graphical analysis:




3. Lithuania:

| Decile group | Income, % of total income | Material benefit, % of total benefit | Personal income tax, % of total personal income tax | Disposable income, % of total disposable income | Income, EUR | Material benefit, EUR | Personal income tax EUR | Disposable income, EUR |
|---|---|---|---|---|---|---|---|---|
| **1** | 1,5 | 27,8 | 0,9 | 1,8 | 95,8 | 27,5 | 7,5 | 136,1 |
| **2** | 2,6 | 40,4 | 1,3 | 4,2 | 186,1 | 39,5 | 12,5 | 294,4 |
| **3** | 2,8 | 16,5 | 2,1 | 4,4 | 187,6 | 16,4 | 18,2 | 324,4 |
| **4** | 3,4 | 6,6 | 2,8 | 5,6 | 241,7 | 6,3 | 26,2 | 400,3 |
| **5** | 5,2 | 3,2 | 4,3 | 7,1 | 346,7 | 3,3 | 38,7 | 510,5 |
| **6** | 8,1 | 3,3 | 7,2 | 9,1 | 545,1 | 3,1 | 65,1 | 666,1 |
| **7** | 9,2 | 1,8 | 8,7 | 10,5 | 634,8 | 1,7 | 80,2 | 752,1 |
| **8** | 13,1 | 0,2 | 13,4 | 13,2 | 904,4 | 0,2 | 124,1 | 953,4 |
| **9** | 18,5 | 0,1 | 20,1 | 16,1 | 1.261,8 | 0,1 | 183,1 | 1.176,7 |
| **10** | 35,6 | 0,2 | 39,3 | 28,1 | 2.445,4 | 0,2 | 360,3 | 2.047,6 |
| **Total:** | 100,0 | 100,0 | 100,0 | 100,0 | 6.849,3 | 98,2 | 915,7 | 7.261,8 |

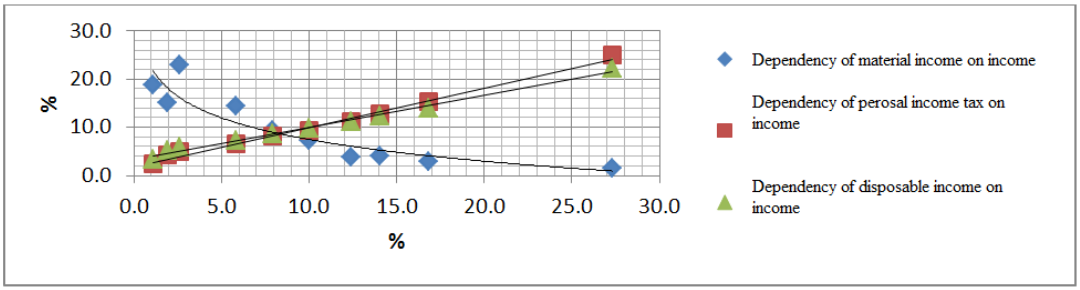
Graphical analysis:




4. Denmark

| Decile group | Income, % of total income | Material benefit, % of total benefit | Personal income tax, % of total personal income tax | Disposable income, % of total disposable income | Income, EUR | Material benefit, EUR | Personal income tax EUR | Disposable income, EUR |
|---|---|---|---|---|---|---|---|---|
| **1** | 1,2 | 18,7 | 2,3 | 3,2 | 514,5 | 197,3 | 377,2 | 1.314,1 |
| **2** | 1,8 | 15,1 | 4,3 | 5,2 | 884,7 | 157,6 | 646,2 | 2.014,7 |
| **3** | 2,7 | 23,1 | 4,8 | 5,8 | 1.232,4 | 241,5 | 749,9 | 2.317,1 |
| **4** | 5,7 | 14,2 | 6,6 | 7,4 | 2.713,7 | 150,1 | 1.008,3 | 2.871,5 |
| **5** | 7,8 | 9,3 | 8,2 | 8,7 | 3.707,5 | 98,3 | 1.275,8 | 3.445,7 |
| **6** | 10,1 | 7,3 | 9,5 | 9,8 | 4.669,7 | 75,7 | 1.454,8 | 3.886,3 |
| **7** | 12,3 | 3,6 | 11,1 | 11,3 | 5.788,2 | 39,2 | 1.729,9 | 4.398,2 |
| **8** | 14,1 | 4,2 | 12,8 | 12,4 | 6.554,8 | 43,4 | 1.964,7 | 4.837,1 |
| **9** | 16,7 | 2,7 | 15,3 | 13,8 | 7.846,1 | 29,6 | 2.382,2 | 5.486,8 |
| **10** | 27,4 | 1,6 | 25,1 | 22,4 | 12.749,1 | 16,2 | 3.853,6 | 8.786,6 |
| **Total:** | 100,0 | 100,0 | 100,0 | 100,0 | 46.661,0 | 1.049,0 | 15.442,5 | 39.358,1 |

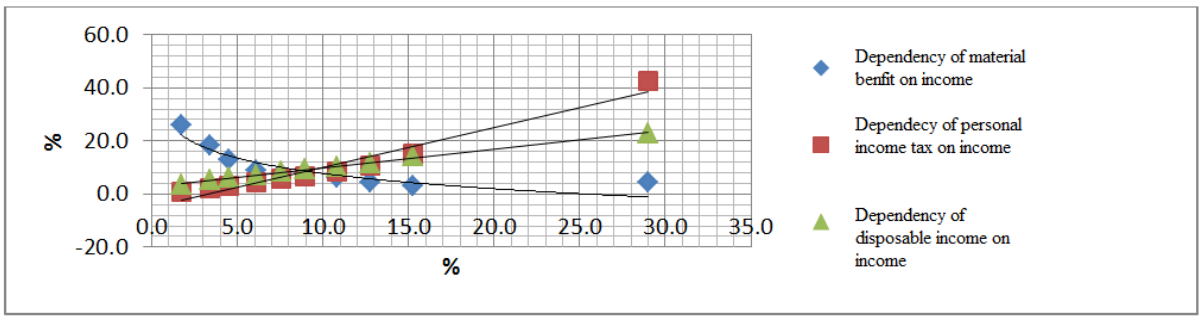
Graphical analysis:



5. France:

| **Decile group** | Income, % of total income | Material benefit, % of total benefit | Personal income tax, % of total personal income tax | Disposable income, % of total disposable income | Income, EUR | Material benefit, EUR | Personal income tax EUR | Disposable income, EUR |
|---|---|---|---|---|---|---|---|---|
| **1** | 1,6 | 25,8 | 1,1 | 3,8 | 484,1 | 392,1 | 55,7 | 1.154,2 |
| **2** | 3,5 | 18,6 | 2,1 | 5,4 | 962,4 | 279,8 | 116,6 | 1.717,2 |
| **3** | 4,4 | 13,1 | 3,1 | 6,4 | 1.267,4 | 197,5 | 181,5 | 1.948,5 |
| **4** | 6,2 | 8,7 | 4,3 | 7,2 | 1.724,1 | 133,4 | 251,1 | 2.268,5 |
| **5** | 7,5 | 7,7 | 5,7 | 8,4 | 2.134,2 | 117,7 | 319,7 | 2.592,8 |
| **6** | 9,1 | 8,1 | 6,8 | 9,3 | 2.531,5 | 120,9 | 392,4 | 2.926,8 |
| **7** | 10,7 | 6,1 | 8,5 | 10,5 | 3.043,3 | 93,3 | 478,4 | 3.242,9 |
| **8** | 12,8 | 4,3 | 10,6 | 11,6 | 3.592,4 | 64,1 | 610,6 | 3.661,9 |
| **9** | 15,1 | 3,1 | 15,4 | 14,4 | 4.294,8 | 48,5 | 870,5 | 4.462,5 |
| **10** | 29,1 | 4,4 | 42,5 | 23,2 | 8.175,1 | 65,9 | 2.431,2 | 7.191,1 |
| **Total:** | 100,0 | 100,0 | 100,0 | 100,0 | 28.209,3 | 1.512,9 | 5.707,5 | 31.166,4 |

Graphical analysis:




Appendix 13. Dependency of EU member states on average personal income tax, highest personal income tax rate, consumption costs, personal income tax within GDP. Regression model. Data source: Eurostat, 2015

| Country | Budget deficit, % of GDP | Average personal income tax, % | Highest personal income tax, % | Country`s consumption expenses, % of GDP | Personal income tax in structure of GDP, % of GDP |
|---|---|---|---|---|---|
| | **y** | **x1** | **x2** | **x3** | **x4** |
| Austria | -2,7 | 20,72 | 50 | 19,9 | 10,04 |
| Belgium | -3,1 | 26,16 | 54 | 24,6 | 12,76 |
| Bulgaria | -5,8 | 8,28 | 10 | 17,1 | 3,08 |
| Cyprus | -8,9 | 9,28 | 35 | 15,7 | 4,28 |
| Croatia | -5,6 | 30,45 | 47 | 19,8 | 3,13 |
| Czech Republic | -1,9 | 9,46 | 22 | 19,6 | 4,12 |
| Denmark | 1,5 | 33,89 | 56 | 26,8 | 25,17 |
| Estonia | 0,7 | 17,61 | 21 | 19,6 | 5,94 |
| Finland | -3,3 | 29,42 | 52 | 24,9 | 13,39 |
| France | -3,9 | 20,25 | 50 | 24,2 | 7,93 |
| Germany | 0,3 | 18,70 | 48 | 19,4 | 8,63 |
| Greece | -3,6 | 15,77 | 46 | 19,8 | 4,83 |
| Hungary | -2,5 | 21,28 | 16 | 19,9 | 6,81 |
| Ireland | -3,9 | 25,51 | 48 | 17,5 | 8,43 |
| Italy | -3,0 | 27,23 | 48 | 19,5 | 11,18 |
| Latvia | -1,5 | 19,02 | 24 | 18,3 | 5,82 |
| Lithuania | -0,7 | 13,30 | 15 | 17,1 | 5,87 |
| Luxembourg | 1,5 | 19,11 | 44 | 17,3 | 7,45 |
| Malta | -2,1 | 11,24 | 35 | 20,2 | 6,20 |
| Poland | -3,3 | 19,48 | 32 | 18,1 | 4,47 |
| Portuga; | -7,2 | 18,36 | 57 | 18,6 | 5,45 |
| Romania | -1,4 | 19,13 | 16 | 14,2 | 3,11 |
| Slovakia | -2,8 | 8,28 | 25 | 18,5 | 2,79 |
| Slovenia | -5,0 | 10,67 | 50 | 19,3 | 5,71 |
| Spain | -5,9 | 15,20 | 52 | 19,2 | 7,9 |
| Sweden | -1,7 | 29,93 | 57 | 26,3 | 16,88 |
| Netherlands | -2,4 | 15,79 | 52 | 25,9 | 7,10 |
| UK | -5,7 | 20,29 | 45 | 19,7 | 10,22 |

Double correlation:

| | y | x1 | x2 | x3 | x4 |
|---|---|---|---|---|---|
| y | 1 | | | | |
| x1 | 0,24705 | 1 | | | |
| x2 | -0,15174 | 0,531882 | 1 | | |
| x3 | 0,224818 | 0,538594 | 0,593438 | 1 | |
| x4 | 0,36508 | 0,719432 | 0,562433 | 0,72806 | 1 |

SUMMARY OUTPUT

*Regression Statistics*

| | |
|---|---|
| Multiple R | 0,57727 |
| R Square | 0,333253 |
| Adjusted R Square | 0,217294 |
| Standard Error | 2,20462 |
| Observations | 28 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 4 | 55,87297 | 13,9682 | 2,873943 | 0,04567 |
| Residual | 23 | 111,788 | 4,860304 | | |
| Total | 27 | 167,65 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -4,10113 | 3,339307 | -1,22815 | 0,231813 | -11,008 | 2,806743 | -11,008 | 2,806743 |
| x1 | 0,040831 | 0,088068 | 0,463639 | 0,647264 | -0,14134 | 0,223017 | -0,14134 | 0,223017 |
| x2 | -0,0972 | 0,037423 | -2,59997 | 0,016010 | -0,17471 | -0,01989 | -0,17471 | -0,01989 |
| x3 | 0,10546 | 0,203212 | 0,519012 | 0,608711 | -0,31492 | 0,525848 | -0,31492 | 0,52588 |
| x4 | 0,262994 | 0,156362 | 1,681942 | 0,10610 | -0,06046 | 0,586454 | -0,06046 | 0,586454 |

Model significance :

H0 – model not statistically significant ( ß0, ß1, ß2, ß3, ß4=0 )

H1 - model statistically significant ( at least one of coefficients is not equal to zero)

| | |
|---|---|
| F - calculated: | 2,873 |
| F- theoretical: | 2,784439 |

2,784<2,873

(95% probability – H0 is rejected)

Primary equation of model

$y=-4,1+0,04x_1-0,1x_2+0,1x_3+0,26x_4$

$\overline{R}^2 = 0.33$

X1 Significance:

H0 - X1 not statistically significant

H1 - X1 statistically significant

| | |
|---|---|
| t Stat | 0,4643 |
| t Stat theoretical | 2,068 |
| | 0,4643<2,068 |

(95% probability – H0 is not rejected)

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,5718567 |
| R Square | 0,3270203 |
| Adjusted R Square | 0,2428976 |
| Standard Error | 2,1682538 |
| Observations | 28 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 3 | 54,8283 | 18,27606 | 3,887428 | 0,021364 |
| Residual | 24 | 112,8317 | 4,701324 | | |
| Total | 27 | 167,67 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -3,6939704 | 3,168627 | -1,1657 | 0,255154 | -10,2336 | 2,845756 | -10,2336 | 2,845756 |
| x2 | -0,0934198 | 0,035875 | -2,6042 | 0,01557 | -0,16745 | -0,01939 | -0,16745 | -0,01939 |
| x3 | 0,1012989 | 0,199665 | 0,507343 | 0,616546 | -0,31078 | 0,513389 | -0,31078 | 0,513389 |
| x4 | 0,301699 | 0,130033 | 2,320185 | 0,029155 | 0,033324 | 0,570072 | 0,033324 | 0,570072 |

X3 Significance:

H0 - X3 not statistically significant

H1 - X3 statistically significant

| | |
|---|---|
| t Stat | 0,534 |
| t Stat theoretical | 2,063 |
| | 0,534<2,063 |
| (95% probability – H0 is not rejected) | |

SUMMARY OUTPUT (X1, X3 not included)

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,565512 |
| R Square | 0,319804 |
| Adjusted R Square | 0,265388 |
| Standard Error | 2,135809 |
| Observations | 28 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 2 | 53,618102 | 26,80904 | 5,877019 | 0,00808 |
| Residual | 25 | 114,0418 | 4,561677 | | |
| Total | 27 | 167,67 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -2,20243 | 1,1643492 | -1,89157 | 0,07018 | -4,60045 | 0,195585 | -4,60045 | 0,195585 |
| x2 | -0,08752 | 0,0334248 | -2,61823 | 0,014798 | -0,15636 | -0,01868 | -0,15636 | -0,01868 |
| x4 | 0,340783 | 0,103185 | 3,302677 | 0,002887 | 0,128273 | 0,553297 | 0,128273 | 0,55327 |

X2 significance

H0 - X2 not statistically significant

H1 - X2 statistically significant

| | |
|---|---|
| t Stat | 2,615 |
| t Stat theoretical | 2,057 |
| | 2,615>2,057 |
| (95% probability – H0 is rejected) | |

Autocorrelation check:

| RESIDUAL OUTPUT | | | | | |
|---|---|---|---|---|---|
| *Observation* | *Predicted Y* | *Residuals (ei )* | *Residuals (ei-1)* | *Residuals (ei -e i-1)^2* | Residuals $(e_i)^2$ |
| 1 | -3,152119885 | 0,452219985 | | | 0,20441247 |
| 2 | -2,546857356 | -0,553342744 | 0,452119995 | 1,010553155 | 0,3059668 |
| 3 | -2,02575116 | -3,77324984 | -0,553142754 | 10,37553093 | 14,2449618 |
| 4 | -3,80335498 | -5,09564602 | -3,77424974 | 1,748731658 | 25,9758006 |
| 5 | -5,262355557 | -0,337544444 | -5,09664612 | 22,648095 | 0,11400376 |
| 6 | -2,721639475 | 0,821538475 | -0,337644444 | 1,343936884 | 0,67508977 |
| 7 | 1,514428306 | -0,014327306 | 0,821638465 | 0,69900590 | 0,00020814 |
| 8 | -2,013615471 | 2,713514471 | -0,014427316 | 7,442211943 | 7,3637034 |
| 9 | -2,142028503 | -1,157872497 | 2,713614461 | 14,98918567 | 1,3409002 |
| 10 | -3,899369891 | -0,000531109 | -1,157972487 | 1,339439088 | 3,983E-07 |
| 11 | -3,413427184 | 3,713325184 | -0,000631119 | 13,79421416 | 13,7895265 |
| 12 | -4,579195456 | 0,979294456 | 3,713425174 | 7,476017672 | 0,95882177 |
| 13 | -1,277387476 | -1,222513524 | 0,979194456 | 4,847958382 | 1,49478384 |
| 14 | -3,525191045 | -0,374709955 | -1,222613534 | 0,71877088 | 0,1404824 |
| 15 | -2,58238236 | -0,41662764 | -0,374809945 | 0,001833355 | 0,17441284 |
| 16 | -2,316576717 | 0,816675617 | -0,41762754 | 1,523257928 | 0,6667958 |
| 17 | -1,510462853 | 0,810461753 | 0,816575727 | 3,73793E-05 | 0,65684843 |
| 18 | -3,474834768 | 4,874833668 | 0,810461843 | 16,51911906 | 23,7640042 |
| 19 | -3,150372044 | 1,050371144 | 4,874833758 | 14,62651512 | 1,10327934 |
| 20 | -3,475214625 | 0,175213525 | 1,050371034 | 0,765900508 | 0,03069982 |
| 21 | -5,287308232 | -1,912690668 | 0,175213615 | 4,359344754 | 3,65838598 |
| 22 | -2,540782942 | 1,140781842 | -1,912690758 | 9,32369558 | 1,30138345 |

| | | | | | |
|---|---|---|---|---|---|
| 23 | -3,43744472 | 0,63743372 | 1,140781932 | 0,253358425 | 0,40632303 |
| 24 | -4,635535726 | -0,364465374 | 0,63743462 | 1,003803597 | 0,13283498 |
| 25 | -4,334123558 | -1,565877442 | -0,364465264 | 1,443391198 | 2,45197215 |
| 26 | -1,424748876 | -0,275252024 | -1,565877432 | 1,66571370 | 0,07576374 |
| 27 | -4,329767732 | 1,929766632 | -0,275252114 | 4,862108157 | 3,72399965 |
| 28 | -2,652617713 | -3,047381187 | 1,929766722 | 24,7720023 | 9,28653272 |
| | | | SUM | 169,5537334 | 113,837485 |
| | | | DW-d | 1,489436733 | |
| | | | dl | 1,036 | |
| | | | du | 1,324 | |
| | | | 4-du | 2,674 | |
| Autocorrelation does not exist, H0 is not rejected when $d_U \leq d \leq 4 - d_u$,.t.y., 1,324≤d ≤2,674 | | | | | |

Heteroskedasticity check: test of Goldfield-Quandt

X2 test:

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,11766188 |
| R Square | 0,01384433 |
| Adjusted R Square | -0,0683352 |
| Standard Error | 2,83549732 |
| Observations | 14 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 1,354458 | 1,354458 | 0,1684642 | 0,688713 |
| Residual | 12 | 96,48053 | 8,040044 | | |
| Total | 13 | 97,834 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -3,8688678 | 2,134157 | -1,81282 | 0,0949328 | -8,5187 | 0,781064 | -8,5187 | 0,781064 |
| x2 | 0,02070088 | 0,050434 | 0,410443 | 0,6887142 | -0,08918 | 0,13058 | -0,08918 | 0,13058 |

RESIDUAL OUTPUT

| *Observation* | *Predicted y* | *Residuals* | Residuals $(e_i)^2$ |
|---|---|---|---|
| 1 | -2,8338246 | 0,133834 | 0,017908 |
| 2 | -2,7572313 | -0,34267 | 0,117492 |
| 3 | -3,661869 | -2,13824 | 4,571648 |
| 4 | -3,1443379 | -5,75556 | 33,12765 |
| 5 | -2,8917871 | -2,70831 | 7,334424 |
| 6 | -3,4134484 | 1,513438 | 2,290525 |
| 7 | -2,7178996 | 4,217889 | 17,79067 |

| | | | |
|---|---|---|---|
| 8 | -3,4341483 | 4,134159 | 17,09118 |
| 9 | -2,8027733 | -0,49733 | 0,247236 |
| 10 | -2,8276123 | -1,07229 | 1,150014 |
| 11 | -2,8855768 | 3,185586 | 10,14788 |
| 12 | -2,9166281 | -0,68347 | 0,466999 |
| 13 | -3,5376547 | 1,037644 | 1,076726 |
| 14 | -2,8752264 | -1,02467 | 1,050164 |
| | | RSS1 | 96,48055 |

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,490328 |
| R Square | 0,240423 |
| Adjusted R Square | 0,177125 |
| Standard Error | 2,101277 |
| Observations | 14 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 16,77067 | 16,77067 | 3,798254 | 0,07508 |
| Residual | 12 | 52,98435 | 4,415363 | | |
| Total | 13 | 69,756 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 0,08925 | 1,657493 | 0,053842 | 0,957947 | -3,52212 | 3,700608 | -3,52212 | 3,700608 |
| x2 | -0,07725 | 0,03964 | -1,94892 | 0,07508 | -0,16357 | 0,009112 | -0,16357 | 0,009112 |

RESIDUAL OUTPUT

| *Observation* | *Predicted y* | *Residuals* | Residuals $(e_i)$^2 |
|---|---|---|---|
| 1 | -3,61047 | 0,610379 | 0,37254 |
| 2 | -1,76453 | 0,264436 | 0,069922 |
| 3 | -1,0683 | 0,369311 | 0,136382 |
| 4 | -3,27835 | 4,678243 | 21,88605 |
| 5 | -2,61412 | 0,514013 | 0,26421 |
| 6 | -2,38241 | -0,91759 | 0,842145 |
| 7 | -4,2756 | -2,9244 | 8,557972 |
| 8 | -1,14664 | -0,25336 | 0,064244 |
| 9 | -1,84176 | -0,95824 | 0,918413 |
| 10 | -3,77266 | -1,22734 | 1,506597 |
| 11 | -3,92714 | -1,97286 | 3,892585 |
| 12 | -4,30559 | 2,605484 | 6,788595 |
| 13 | -3,92714 | 1,527027 | 2,331842 |

| | | | |
|---|---|---|---|
| 14 | -3,38648 | -2,31352 | 5,352818 |
| | | RSS2 | 52,98434 |

| | |
|---|---|
| F calculated: | 0,548 |
| F theoretical: | 3,276 |

0,548<3,276 model is homoscedastic in respect of X2

X4 test:

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,55693216 |
| R Square | 0,31017343 |
| Adjusted R Square | 0,25268788 |
| Standard Error | 2,37151822 |
| Observations | 14 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 30,34583 | 30,34583 | 5,3956766 | 0,038568 |
| Residual | 12 | 67,48919 | 5,624098 | | |
| Total | 13 | 97,836 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -5,2738756 | 1,148178 | -4,59325 | 0,0006182 | -7,77553 | -2,77222 | -7,77553 | -2,77222 |
| x4 | 0,26229425 | 0,112918 | 2,32285 | 0,0385668 | 0,016265 | 0,508324 | 0,016265 | 0,508324 |

RESIDUAL OUTPUT

| *Observation* | *Predicted y* | *Residuals* | Residuals $(e_i)^2$ |
|---|---|---|---|
| 1 | -2,6369815 | -0,06312 | 0,003972 |
| 2 | -1,9219034 | -1,1791 | 1,387915 |
| 3 | -4,4643151 | -1,33579 | 1,784058 |
| 4 | -4,1485756 | -4,75133 | 22,57605 |
| 5 | -4,4497831 | -1,15032 | 1,323002 |
| 6 | -4,1916424 | 2,291651 | 5,25161 |
| 7 | 1,33195795 | 0,168052 | 0,028237 |
| 8 | -3,7140487 | 4,414058 | 19,48383 |
| 9 | -1,758489 | -1,5425 | 2,376224 |
| 10 | -3,1919156 | -0,70819 | 0,501384 |
| 11 | -3,0064946 | 3,306484 | 10,9328 |
| 12 | -4,0047972 | 0,40486 | 0,16385 |
| 13 | -3,4841745 | 0,984164 | 0,968597 |
| 14 | -3,0588392 | -0,84126 | 0,707554 |

| | | | |
|---|---|---|---|
| | | RSS1 | 67,48917 |

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,032928 |
| R Square | 0,001085 |
| Adjusted R Square | -0,08215 |
| Standard Error | 2,409693 |
| Observations | 14 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 0,075638 | 0,075638 | 0,013025 | 0,911022 |
| Residual | 12 | 69,67937 | 5,806615 | | |
| Total | 13 | 69,756 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -3,09882 | 1,454213 | -2,13093 | 0,054467 | -6,26727 | 0,069647 | -6,2672 | 0,069647 |
| x4 | 0,020948 | 0,183536 | 0,114132 | 0,911022 | -0,37895 | 0,420835 | -0,3789 | 0,420835 |

RESIDUAL OUTPUT

| *Observation* | *Predicted y* | *Residuals* | Residuals $(e_i)^2$ |
|---|---|---|---|
| 1 | -2,8655 | -0,1345 | 0,018362 |
| 2 | -2,97662 | 1,476733 | 2,18072 |
| 3 | -2,97569 | 2,275576 | 5,178292 |
| 4 | -2,94259 | 4,342476 | 18,85719 |
| 5 | -2,9678 | 0,868813 | 0,754819 |
| 6 | -3,00481 | -0,29519 | 0,087078 |
| 7 | -2,9855 | -4,2145 | 17,77043 |
| 8 | -3,03364 | 1,633548 | 2,668445 |
| 9 | -3,04014 | 0,24034 | 0,057716 |
| 10 | -2,9784 | -2,0206 | 4,082807 |
| 11 | -2,95002 | -2,94978 | 8,7017 |
| 12 | -2,74483 | 1,044939 | 1,091875 |
| 13 | -2,94975 | 0,549841 | 0,302335 |
| 14 | -2,88452 | -2,81568 | 7,927516 |
| | | RSS2 | 69,67935 |

| | |
|---|---|
| F : | 1,031 |
| F theoretical: | 3,269 |

1,031<3,269 model is homoscedastic in respect X4.
Model itself is heteroskedastic

Final model equation:

$y=-2,2-0,09x_2+0,34x_4$

$\overline{R}^2 = 0.57$

Appendix 14. Dependency of EU member states personal income tax on average personal income tax, highest personal income tax and annual net salary. Regression model. Data: Eurostat, 2012.

| Country | Personal income tax, %cof GDP | Avereage of personal income tax rate, % | Highest personal income tax rate, % | Average annual net salary, EUR |
|---|---|---|---|---|
| | **y** | **x1** | **x2** | **x3** |
| Austria | 10,13 | 20,42 | 50 | 15931 |
| Belgium | 12,71 | 26,28 | 54 | 16629 |
| Bulgaria | 2,93 | 8,30 | 10 | 1799 |
| Cyprus | 3,98 | 9,41 | 35 | 22512 |
| Croatia | 3,68 | 30,43 | 47 | 4707 |
| Czech Republic | 3,76 | 8,63 | 15 | 5103 |
| Denmark | 24,47 | 34,03 | 55 | 16948 |
| Estonia | 5,34 | 17,15 | 21 | 4588 |
| Finland | 12,97 | 28,22 | 49 | 1022 |
| France | 8,46 | 18,44 | 51 | 14439 |
| Germany | 8,81 | 18,57 | 48 | 15254 |
| Greece | 6,93 | 14,84 | 49 | 8857 |
| Hungary | 5,38 | 22,95 | 20 | 3113 |
| Ireland | 9,72 | 20,71 | 48 | 15784 |
| Italy | 12,23 | 27,68 | 47 | 11367 |
| Latvia | 5,71 | 19,66 | 25 | 3219 |
| Lithuania | 3,53 | 13,13 | 15 | 2982 |
| Luxembourg | 8,63 | 17,62 | 41 | 21774 |
| Malta | 6,76 | 11,22 | 35 | 9220 |
| Poland | 4,58 | 19,31 | 32 | 3599 |
| Portuga; | 5,94 | 13,42 | 49 | 7583 |
| Romania | 3,49 | 18,91 | 16 | 2084 |
| Slovakia | 2,63 | 8,11 | 19 | 4133 |
| Slovenia | 5,86 | 11,18 | 41 | 6758 |
| Spain | 7,76 | 15,04 | 52 | 11446 |
| Sweden | 15,21 | 30,04 | 57 | 17808 |
| Netherlands | 7,67 | 15,86 | 52 | 18602 |
| UK | 9,63 | 20,28 | 50 | 18170 |

Dual correlation:

| | y | x1 | x2 | x3 |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| y | 1 | | | |
| x1 | 0,730014 | 1 | | |
| x2 | 0,683206 | 0,545515 | 1 | |
| x3 | 0,609627 | 0,304515 | 0,733204 | 1 |

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,838785 |
| R Square | 0,703561 |
| Adjusted R Square | 0,666506 |
| Standard Error | 2,697366 |
| Observations | 28 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 3 | 414,4373 | 138,1457 | 18,98705 | 1,58E-06 |
| Residual | 24 | 174,6188 | 7,275787 | | |
| Total | 27 | 589,0562 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -3,08178 | 1,619928 | -1,90242 | 0,069183 | -6,42515 | 0,261576 | -6,42515 | 0,261576 |
| X Variable 1 | 0,363552 | 0,08792 | 4,135465 | 0,000375 | 0,182113 | 0,544988 | 0,182113 | 0,544988 |
| X Variable 2 | 0,038678 | 0,059143 | 0,653984 | 0,519342 | -0,08338 | 0,160747 | -0,08338 | 0,16074 |
| X Variable 3 | 0,000245 | 0,000116 | 2,110655 | 0,04542 | 5,45E-06 | 0,000488 | 5,45E-06 | 0,000488 |

Model significance:

H0 – model is not statistically significant ( ß0, ß1, ß2, ß3=0 )

H1 - model is statistically significant (at least one coefficient is not equal to zero)

| | |
|---|---|
| F calculates | 18,97805 |
| F theoretical | 3,008686 |

3,01<18,98

(95% probability, H0 is rejected)

Primary equation of regression:

y=-3,08179+0,363551x1+0,038679x2+0,000246x3

$\overline{R}^2 = 0.666507$

X2 significance:

H0 - X2 is not statistically significant

H1 - X2 statistically significant

| | |
|---|---|
| t Stat | 0,647 |

| | |
|---|---|
| t Stat theoretical | 2,064 |
| | 0,647<2,064 |
| (95% probability, H0 is not rejected) | |

SUMMARY OUTPUT (X2 not included)

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,835632 |
| R Square | 0,698278 |
| Adjusted R Square | 0,674142 |
| Standard Error | 2,666315 |
| Observations | 28 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 2 | 411,3257 | 205,6629 | 28,92898 | 3,13E-07 |
| Residual | 25 | 177,7308 | 7,109229 | | |
| Total | 27 | 589,0564 | | | |

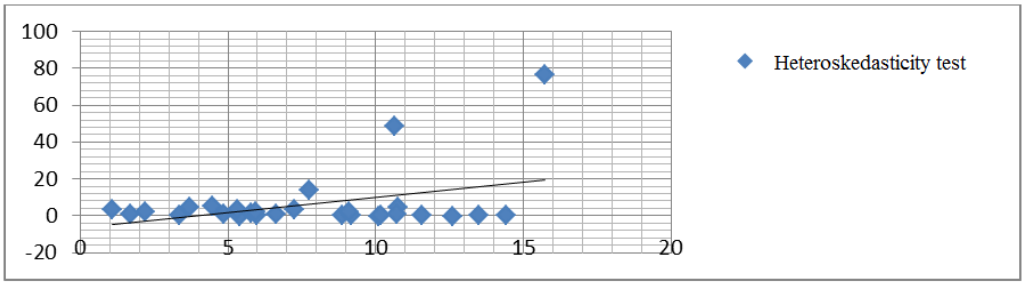
| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -2,70052 | 1,493976 | -1,8077 | 0,082719 | -5,7775 | 0,376393 | -5,7775 | 0,376393 |
| X Variable 1 | 0,392153 | 0,075382 | 5,202316 | 2,21E-05 | 0,236903 | 0,547404 | 0,236903 | 0,547404 |
| X Variable 2 | 0,0004 | 8,12E-05 | 3,701506 | 0,001063 | 0,000134 | 0,000469 | 0,000134 | 0,000469 |

Autocorrelation check:

| *Observation* | *Predicted Y* | *Residuals (ei )* | *(ei-1)* | *(ei -e i-1)^2* | $(e_i)^2$ |
|---|---|---|---|---|---|
| 1 | 10,09896 | 0,023502 | | | 0,000553 |
| 2 | 12,6068 | 0,110296 | 0,023513 | 0,007534 | 0,012166 |
| 3 | 1,097267 | 1,855263 | 0,110287 | 3,04490 | 3,441999 |
| 4 | 7,758294 | -3,76566 | 1,855272 | 31,59493 | 14,1804 |
| 5 | 10,65085 | -6,95915 | -3,76587 | 10,19827 | 48,4298 |
| 6 | 2,220257 | 1,545625 | -6,95924 | 72,33114 | 2,38897 |
| 7 | 15,74156 | 8,743118 | 1,545636 | 51,80392 | 76,44214 |
| 8 | 5,409026 | -0,06136 | 8,743129 | 77,51899 | 0,003767 |
| 9 | 13,48529 | -0,50674 | -0,06147 | 0,198364 | 0,256793 |
| 10 | 8,874236 | -0,40732 | -0,50685 | 0,009888 | 0,165904 |
| 11 | 9,168873 | -0,37125 | -0,40741 | 0,001302 | 0,137823 |
| 12 | 5,782718 | 1,157187 | -0,37134 | 2,336104 | 1,339085 |
| 13 | 7,240398 | -1,84543 | 1,157178 | 9,015767 | 3,405645 |
| 14 | 10,16735 | -0,4593 | -1,84554 | 1,921667 | 0,210862 |
| 15 | 11,57365 | 0,664135 | -0,4582 | 1,26188 | 0,441078 |
| 16 | 5,979755 | -0,28176 | 0,664146 | 0,894694 | 0,079382 |
| 17 | 3,346483 | 0,17418 | -0,28185 | 0,207872 | 0,030338 |
| 18 | 10,74579 | -2,12396 | 0,174192 | 5,281427 | 4,511178 |

| *Observation* | *Predicted Y* | *Residuals (ei )* | *(ei-1)* | *(ei -e i-1)^2* | $(e_i)^2$ |
|---|---|---|---|---|---|
| 19 | 4,464847 | 2,280448 | -2,12385 | 19,39877 | 5,200448 |
| 20 | 5,948014 | -1,376 | 2,280459 | 13,38422 | 1,898872 |
| 21 | 4,845044 | 1,087756 | -1,388 | 6,079936 | 1,183216 |
| 22 | 5,335598 | -1,85801 | 1,087767 | 8,677622 | 3,45226 |
| 23 | 1,719425 | 0,89972 | -1,85812 | 7,605092 | 0,809479 |
| 24 | 3,709588 | 2,135775 | 0,89981 | 1,527857 | 4,561534 |
| 25 | 6,630455 | 1,117636 | 2,135784 | 1,0366089 | 1,249108 |
| 26 | 14,42766 | 0,770435 | 1,117665 | 0,120548 | 0,593568 |
| 27 | 9,105842 | -1,44738 | 0,770443 | 4,918748 | 2,094944 |
| 28 | 10,71618 | -1,09985 | -1,44749 | 0,120792 | 1,20966 |
| | | | SUM | 330,4989 | 177,7301 |
| | | | | | |
| | | | DW-d | 1,859555 | |
| | | | | | |
| | | | dl | 1,036 | |
| | | | du | 1,325 | |
| | | | 4-du | 2,675 | |
| Autocorrelation does not exist, H0 is not rejected when $d_U \leq d \leq 4 - d_u$,.it is., 1,325≤d ≤2,675 | | | | | |

Heteroskedasticity test:




Final equation of regression:

$y=-2,70051+0,392154x_1+0,0003x_3$

$$\overline{R}^2 = 0,6741412$$

Appendix 15. EU member states dependency of unemployment on average personal income tax rate, highest personal income tax rate, average annual net salary. Regression model. Data: Eurostat, 2012

| Country | Unemployment rate, % of population | Average of personal income tax rate, % | Highest personal income tax rate, % | Average annual net salary, EUR |
|---|---|---|---|---|
| | **y** | **x1** | **x2** | **x3** |
| Austria | 8,6 | 20 | 50 | 15931 |
| Belgium | 12 | 26 | 54 | 16629 |
| Bulgaria | 26,9 | 83 | 10 | 1799 |
| Cyprus | 12,5 | 94 | 35 | 22512 |
| Czech Republic | 24,4 | 86 | 15 | 5103 |
| Denmark | 9,5 | 34 | 55 | 16948 |
| Estonia | 22 | 17 | 21 | 4588 |
| Finland | 22,5 | 28 | 49 | 17022 |
| France | 13,6 | 18 | 51 | 14439 |
| Germany | 13 | 19 | 48 | 15254 |
| Greece | 25 | 15 | 49 | 8856 |
| Hungary | 23 | 23 | 20 | 3113 |
| Ireland | 23,2 | 21 | 48 | 15783 |
| Italy | 12 | 28 | 47 | 11366 |
| Latvia | 23 | 20 | 25 | 3219 |
| Lithuania | 36 | 13 | 15 | 2981 |
| Luxembourg | 6,3 | 18 | 41 | 21774 |
| Malta | 7,8 | 11 | 35 | 9220 |
| Poland | 18 | 20 | 32 | 3599 |
| Portuga; | 16 | 13 | 49 | 7582 |
| Romania | 7 | 19 | 16 | 2083 |
| Slovakia | 42 | 81 | 19 | 4133 |
| Slovenia | 14 | 11 | 41 | 6757 |
| Spain | 31.3 | 15 | 52 | 11446 |
| Sweden | 12,3 | 30 | 57 | 17807 |
| Netherlands | 6,5 | 16 | 52 | 18602 |
| UK | 10,2 | 20 | 50 | 18170 |

Dual correlation:

| | y | x1 | x2 | x3 |
|---|---|---|---|---|
| y | 1 | | | |
| x1 | -0,44366 | 1 | | |
| x2 | -0,51623 | 0,541706 | 1 | |
| x3 | -0,58574 | 0,389925 | 0,770514 | 1 |

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,6306948 |
| R Square | 0,3977757 |
| Adjusted R Square | 0,3192248 |
| Standard Error | 7,7097707 |
| Observations | 27 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 3 | 903,00697 | 301,00233 | 5,06393 | 0,007724 |
| Residual | 23 | 1367,1331 | 59,440567 | | |
| Total | 26 | 2270,13 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 31,161927 | 4,7425146 | 6,5707607 | 1,05E | 21,35128 | 40,972 | 21,351 | 40,97258 |
| X Variable 1 | -0,3403326 | 0,2615642 | -1,301143 | 0,2061 | -0,88141 | 0,2007 | -0,8814 | 0,200755 |
| X Variable 2 | -0,0067106 | 0,172696 | -0,038859 | 0,9692 | -0,36395 | 0,3505 | -0,3639 | 0,35055 |
| X Variable 3 | -0,00066 | 0,0003568 | -1,886765 | 0,0719 | -0,00142 | 6,49E | -0,0014 | 6,49E-05 |

Model significance:

H0 – model is not statistically significant (ß0, ß1, ß2, ß =0 )

H1 – model is statistically significant (at least one coefficient is not equal to zero)

| | |
|---|---|
| F calculated: | 5,063821 |
| F theoretical | 3,027898 |

5,063>3,028

(95% probability, H0 is rejected)

Primary equation of regression:

$y=31,1619-0,3403x_1-0,0007x_2-0,0006x_3$

$\overline{R}^2 = 0,319225$

X2 significance

H0 - X2 is not statistically significant
H1 - X2 statistically significant

| | |
|---|---|
| t Stat | -0,038855631 |
| t Stat theoretical | 2,068667599 |

-0,038<2,068

(95% probability, H0 is not rejected)

SUMMARY OUTPUT (X2 not included)

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,630663425 |
| R Square | 0,397736356 |
| Adjusted R Square | 0,347547718 |
| Standard Error | 7,54768948 |
| Observations | 27 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 2 | 902,917207 | 451,458605 | 7,924828 | 0,002278 |
| Residual | 24 | 1367,222793 | 56,96761634 | | |
| Total | 26 | 2270,15 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 31,0903885 | 4,278701364 | 7,266314183 | 1,66E-07 | 22,25957 | 39,92118 | 22,25957 | 39,92118 |
| X Variable 1 | -0,34451049 | 0,233434017 | -1,47583667 | 0,152989 | -0,82628 | 0,137275 | -0,82628 | 0,137275 |
| X Variable 2 | -0,00068345 | 0,000241555 | -2,82937456 | 0,009274 | -0,00117 | -0,00019 | -0,00117 | -0,00019 |

X1 significance:

H0 - X1 is not statistically significant

H1 - X1 statistically significant

| | |
|---|---|
| t Stat | -1,475835582 |
| t Stat theoretical | 2,063889547 |

-1,47<2,063

(95% probability, H0 is not rejected)

SUMMARY OUTPUT (X2, X1 not included)

| *Regression Statistics* | |
|---|---|
| Multiple R | 0,585729095 |
| R Square | 0,343078573 |
| Adjusted R Square | 0,316801716 |
| Standard Error | 7,723480072 |
| Observations | 27 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 778,8363898 | 778,8363898 | 13,0564 | 0,001328 |
| Residual | 25 | 1491,30362 | 59,65214442 | | |
| Total | 26 | 2270,15 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95,0%* | *Upper 95,0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 26,37192022 | 2,909733862 | 9,063344447 | 2,24E-09 | 20,37922 | 32,36464 | 20,37922 | 32,36464 |
| X Variable 1 | -0,00082242 | 0,000227616 | -3,61335048 | 0,001328 | -0,00128 | -0,00036 | -0,00128 | -0,00036 |

X3 significance:

H0 - X3 is not statistically significant

H1 - X3 statistically significant

| | |
|---|---|
| t Stat | -3,61353047 |
| t Stat theoretical | 2,059358536 |

-3,613<2,059

(95% probability, H0 is not rejected)

Final equation of regression:

$y=26,3719-0,000822x_4$

$\overline{R}^2 = 0,3168$