# Charles University in Prague

# Faculty of Social Sciences

## Institute of Economic Studies

# Master Thesis

**2008**                                    **Karel Herbst**

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# Is the Concept of the Laffer Curve Valid ?

The Empirical Evidence from the Corporate Income Tax for Selected
OECD Countries

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Hereby I claim that I elaborated this master thesis on my own, and that the only literature and sources I used are those listed in references.

30<sup>th</sup> of June 2008                                                            author's signature

Prohlášení

Prohlašuji, že jsem magisterskou práci vypracoval samostatně a použil pouze uvedené prameny a literaturu.

V Praze, 30.6. 2008                                                            podpis autora

# Acknowledgments

# Teze diplomové práce

**Topic:**

Is the Concept of Laffer Curve Valid ? The Evidence from the EU Countries.

**Aim of the paper**:

The tax systems in the European Union countries has changed and developed in recent years. There are countries and tendencies to tax harmonization (mainly from the old EU-15), on the other hand, most of the new member states prefer tax competition in order to attract foreign investors to invest in those countries. Moreover, different governments have different understanding of the size of the public sector and that also affects the tax rates. As a result the tax systems and different tax rates are not fixed, but rather they are changing over time.

The concept of Laffer curve is well-know and this paper would like to examine this concept and find evidence for it in the experince of the European Union countries. The primary hypothesis of this thesis should be the validity of concept of Laffer curve in the European Union environment. The econometric model will be used to examine the dependence of the revenue of the state budget on levels of tax rates in the EU countries. From those results we will be able to decide whether this concept of Laffer curve is in the EU environment plausible. Moreover, we will be able to see if there is a general Laffer curve for EU countries or there is different curve for different countries.

The structure of the thesis would be as follows. First, the theoretical framework about the taxes, their purpose, their level and also the concept of Laffer curve will be developed. Then, the paper will focus on the structure of tax systems in different EU countries and differences of tax levels in those countries. Those data then will be used in the econometric model, which was explained above.

**These questions should be answerd in the thesis:**

Why is there taxation ?
Why the level of taxation is relatively high in European Unin ?
What are the different tax systems and different tax tendencies in the EU ?
What are the level of different taxes in EU countries and what were their values in the past ?
Is there an evidence for the Laffer curve in the EU countries ?
Is there an unified Laffer curve for the EU countries ?

**Preliminary Structure of the Paper:**

    I.  Concept of taxes and their purpose
   II.  Laffer Curve
  III.  Different tax systems and differences in tax levels in the EU countries
  IV.  The Model (dependence of state budget revenue on tax rates)
   V.  Conclusions


**Basic literature:**

**Buchanan, J.- Lee, D. (1982):** Politics, Time and the Laffer Curve. In The Journal of Political Economy, Vol. 90, No. 4. (Aug., 1982), pp. 816-819.

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**Mueller, D.C. (2004)**: Public Choice III, 3rd edition, Cambridge University Press.

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V Praze dne 20. 9. 2007



 Podpis vedoucího diplomové  práce                      Podpis autora
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# Abstract

This thesis deals with the issue of Laffer curve. According to the idea of Laffer curve when the tax rate exceeds certain treshold (revenue-maximizing tax rate) the tax revenue would in absolute terms decrease with rising tax rate. Therefore this thesis tries to discover whether those facts are valid in the corporate income taxation for 20 OECD countries for the time period from 1965 to 2006.

The structure of the thesis could be divided into three parts. In first introductory chapters we would  discuss the issue of taxation in general. We will briefly examine the history of taxation and explore the theory of taxation and tax systems. The second part of this thesis will focus on the Laffer curve in detail. Third chapter will introduce the theory behind Laffer curve and discuss its properties for different types of taxation. In the following chapter the literature and different possibilities of estimation of Laffer curve and (or) Laffer effects would be reviewed. Fifth chapter focuses on the corporate income taxation *per se* and examine the development of corporate income tax revenue and rates in our sample countries.

In the last part of this thesis the econometric estimates the Laffer curve for corporate income taxation are presented. The Laffer curve would be estimated for three selected countries and then for the whole sample of 20 OECD countries on the panel data. Last section then states conclusions of this thesis, mainly that the Laffer effects for corporate income taxation were confirmed and thus the traditional shape of the Laffer curve was validated.

# Abstrakt

Tato diplomová práce se zabývá Lafferovou křivkou. Teorie Lafferovy křivky nám říká, že pokud výše daňové sazby překročí určitou mez (daňová sazba maximalizující příjmy), tak daňové výnosy budou dále v absolutních číslech klesat se vzrůstající daňovou sazbou. Proto se tato práce snaží zjistit, zda jsou tyto skutečnosti platné pro daň z příjmu korporací pro 20 OECD zemí v časovém období od roku 1965 do 2006.

Struktura práce může být rozdělena do tří částí. V prvních dvou úvodních kapitolách bude krátce diskutována historie a teorie zdanění a daňových systémů. Druhá část práce se zaměří na Lafferovu křivku. Třetí kapitola prozkoumá teorii Lafferovy křivky a bude diskutovat její vlastnosti pro různé druhy daní. V následující kapitole je zhodnocena literatura týkající se možných způsobů odhadů této křivky a Lafferových efektů. Pátá kapitola se pak zaměřuje na korporátní daň z příjmu a zkoumá vývoj daňových sazeb a státních výnosů v našem vzorku zemí.

V poslední části této práce jsou prezentovány ekonometrické odhady Lafferovy křivky pro daň z příjmu korporací. Nejdříve je Lafferova křivka odhadnuta pro tři vybrané země a poté pro celý vzorek 20 OECD zemí na základě panelových dat. Závěrečná sekce poté činí závěry z naší analýzy, především potvrzuje, že tradiční tvar Lafferovy křivky pro korporátní daň z příjmu byl ověřen.


**JEL Klasifikace:** H25, H87

**Klíčová slova:** Lafferova křivka, Lafferovy efekty, daň z příjmu korporací, státní výnosy z daně z příjmu korporací

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# List of Tables and Figures

# List of Abbreviations

ADF - Augmented Dickey Fuller test

DW – Durbin Watson stats.

EC - European Communities

EU - European Union

GDP – Gross Domestic Product

JB – Jarque-Bera test

OECD – Organization for Economic Cooperation and Development

OLS-Ordinary Least Squares

VAT – Value Added Tax

U.S. – United States

# Introduction

*It has been said that the virtue of the Laffer curve is that you can explain*
*it to a congressman in half an hour and he can talk about it for six months.*

Hal Varian (Intermediate Microeconomics)

This thesis will deal with the issue of Laffer curve. As the quotation suggests the concept of this curve and the theory behind is fairly simple. The basic idea lies in the fact that the tax revenue depend on the tax rates, however the dependence is not linear. According to the idea of Laffer curve when the tax rate exceeds certain treshold (revenue-maximizing tax rate) the tax revenue decrease with rising tax rate. More detailed explanation would be given further in the text. We would thus explore whether this concept is valid for corporate income taxation and whether we can estimate the Laffer curve for selected OECD (Organization of Economic Cooperation and Development) countries.

We can divide the structure of the thesis into three parts. In first introductory chapters we would  discuss the **issue of taxation in general**. We will briefly examine the history of taxation and explore the theory of taxation and tax systems. The main emphasis would be devoted to the size of the state sector. This analysis would show us that the state sector grew significantly in last century and therefore there was growing requirements for the funds to finance the state activities. Thus it is legitimate to investigate whether further increase in taxes would constitute the increase of revenue or not.

In the second part of the thesis we focus on the **Laffer curve in detail**. Third chapter will introduce the theory behind Laffer curve and discuss its properties. In the following chapter we would review the literature and different possibilities of estimation of Laffer curve and (or) Laffer effects. Fifth chapter serve as a bridge between the second and third part of this thesis. It focuses on the corporate income taxation and we would examine the development and its possible explanations of corporate income tax revenue and rates in sample of 20 OECD countries for the time period from 1965 to 2006.

Last two chapters **estimate the Laffer curve** for corporate income taxation using the econometric models. In chapter six we try to estimate the Laffer curve for three selected countries (Ireland, France and the United Kingdom) using the time-series estimation technique. In the final chapter the Laffer curve will be estimated for the whole sample of 20 OECD countries on the panel data. Last section then concludes.

Before we proceed, we can state two hypothesis about the estimations of Laffer curve. We would hypothesize that Laffer effects will be significant for corporate income taxation and thus the standard shape of the Laffer curve would be confirmed by our estimates. Moreover, we suppose that there are certain differences in the tax systems and tax revenue collection among OECD countries and thus the results would differ for different countries. This hypothesis is also one of the reasons why we included the country-specific estimates into our analysis in chapter six. Let us now shortly review the history of taxation in the first chapter.

# 1     A Brief History of Taxation

This passage is rather an overview of some important aspects in the history of taxation and therefore it is not a comperhensive summary. It also focuses mainly on the western countries such as European countries and to some extend the United States (U.S.). The history of taxation goes far back to the ancient times and is highly connected to the development of states.

## *1.1  Ancient Period*

The first known system of taxation was discovered in **Ancient Egypt** around 3000 BC - 2800 BC in the first dynasty of the Old Kingdom. Administrative texts, literary texts, letters and scenes from tombs have provided evidence that the taxes and tax collectors were present at that time. The pharaoh would then conduct a bienneial royal tour around the country and the inhabitans of Egypt and thus he collected taxes.[1]

The early taxation is also mentioned in the **Bible**:

*But when the crop comes in, give a fifth of it to Pharaoh. The other four-fifths you may keep as seed for the fields and as food for yourselves and your households and your children.*[2]

However taxes did not play the major role in the ancient world. The purpose of the taxation was mainly to finance military forces, public buildings and administration of the given territory. The tax collection was mainly irregular and especially the in-kind and corvée taxation were typical for the ancient era.[3]

### 1.1.A Ancient Rome

As an example we can take one of the greatest empire of that era - Ancient Rome and examine its system of taxation little closer.[4] Roman empire relied on the tribute from state-owned resources. The second source of the state income was the tax collection. Apart from military purposes and public administration the expenditures of the Roman empire went

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[1] In University of Pennsylvania (2002).
[2] In Holy Bible – New International Vesion (1978) chapter 47, verse 24.
[3] In Urbášková (1998).
[4] This section about Ancient Rome is based mainly on Angresano (1995), pp.39-60.

for the entertainment, the city of Rome's grain supply and salaries of civil servants. The system of taxation in Ancient Rome consisted of three main taxes.

There was a poll tax[5] on adults between the age of 12 to 65. This tax was imposed on males or on all adults depending upon the province. However, the largest revenue came from the property tax. It was a fixed amount and therefore it did not vary with the size of the crop.

Another important tax was the harbor tax, which would have been called customs duties in the present days. The rate was set between 2 - 2,5 % of the value of goods imported into the empire. The remarkable exception were the luxury goods imported from eastern provinces which faced 25 % import duty. This rather high rate was set for two purposes. It should have discouraged the outflow of the currency from Rome and obtain the revenue from wealthy Romans. Their demand for the luxury goods was highly inelastic and therefore their willingness to buy those goods did not decrease much even with that high tax rate.[6]

This system of taxation and state policies led to the situation where Romans residing in Italy benefited. They were responsible for paying only the miscellaneous taxes, however they enjoyed the most fruits of state redistribution. They enjoyed the benefits of protection, public services and free grain (inhabitants of Rome) and all this was financed primarily by the provinces.[7]

Thanks to the previous short excursion to the system of ancient taxation, it is apparent that the redistribution role of taxation played significant function. It is also obvious that it was not always the redistribution from rich to poor, rather it depended on the place where the inhabitants of the Roman empire were settled.

## 1.2  Taxation in the Middle Ages

In different territories different state systems and thus different tax systems were evolving during that time, however we could observe some similarities in the forms of taxation which were collected. The following section shortly summarize these similarities.

The most important resource and factor of production in the **feudal system** was land. Therefore its ownership was the key factor which was subject to taxation. The original owner of the land was the monarch. He either administer the land by his own vassals or he gave the

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[6] In Angresano (1995), pp. 40-47.
[7] Ibid, p.50.

land to the barons or to the Church[8] or he might have lent the land to the vassals or peasants. Therefore land was either publicly owned (by the monarch), owned by the Church, by private individuals (such as barons, vassals and peasants) or by group acting cooperatively.[9]

Frequently the tenancy of the land was somehow taxed by the landlords or by the monarch. Another forms of taxation were, *inter alia,* the mandatory gifts for the emperor, import duties, and every holder of the land[10] was obliged to provide either military service or labor in return for the right to til his land.[11]

## 1.2.A Taxation System in the Cities

The situation in the cities was rather different than in the feudal manors. As time was flowing, the cities earned major importance in the Middle Ages' system. The most important factor of production in the cities was apparently the labor. Craftsmen and merchants associated into guilds, which had the eminent privilege from the monarch to manufacture the products and run the business.

With the evolution of cities and monetary system, apart from in-kind and labor taxation, the monetary taxation started to play an important role. Those monetary taxes could have been indirect (paid on transaction of goods) or direct (paid on wealth or on income).[12] Many cities have also negotiated some sort of charters (e.g. to brew beer) with the monarch and evidently the cities have paid some sort of tax for this privilege.

Before we proceed to the modern period of our history we could summarize the feudal system of the Middle Ages and its implications for the on-coming period. The public expenditures mainly on evolving professional military forces, administration and judiciary significantly rose.[13] Thus the need of taxation was more considerable. That is why the monetary taxes started to play much more important role and the main income of the public budget changed from the feudal in-kind taxes to the monetary taxation of the cities. However, the taxation was still mainly irregular and non-lasting. Consequently, the monarch had to appeal the nobility for the permission to introduce certain tax repeatedly.

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[8] Obviously this gratuity of the monarch was not disintrested and the monarch required some services in return. See e.g. Angresano (1995), pp. 63-69 for further details.
[9] In Angresano (1995), p. 74.
[10] This could have been ordinary peasant or even the duke.
[11] In Salanié (2003), p. 2.
[12] In Salanié (2003), p. 2., for further discussion see next chapter.
[13] In Grúň (2004), p. 38.

# *1.3  Pre-Modern Period*

The modification of the taxation system is a long term process. However, during the 15[14] and 16th century the taxation system started to gradually function on the basis of regular and periodical revenue.[14] Therefore taxes became permanent source of state budget and fiscal policy began to form.

The European countries started to discover new land mainly in Africa and America and they began to derive benefits from their colonial possesions. Also the trade policy of the colonial powers have changed and the emphasis was given on the custom duties, internal (between provincies) as well as external.[15] The custom duties thus became the main source of the state budget in the colonial powers. States started to be heavily protective and in accordance with the mercantilism they put emphasis on the foreign trade as the most important policy. Hence, they exported their manufactured goods mainly to their colonies and the custom duties on imports to those countries were set very high in order to collect revenue to the state budget as wel as to protect the domestic market from massive inflow of imports.

## 1.3.A Introduction of Income Taxes

The Napoleonic wars and the need of countries to finance the growing war expenditures led certein governments to introduce first modern income taxes. In England the tax reform which created this income tax took place in year 1798.[16] The indirect taxes and customs duties could have been thus lowered. However, in peace time the income tax was again abolished and  in England was re-established by the prime minister Robert Peel in year 1842.[17] Other countries followed this suit of England and income tax was introduced in Prussia, France and after overcoming the constitutional objectives of the Supreme Court this tax was introduced in the United States as well in the beggining of the 20th century.[18]

## 1.3.B Growing State Expenditures

The rising expenditures of the state budget were not caused solely by the war expenditures. The state bureaucracy started to influence the life of people in many spheres of life. Some domains of private sphere were increasingly influenced by the state sector. We

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[14] Ibid, p. 39.
[15] In Salanié (2003), p. 3.
[16] See Grúň (2004), p.47 for details.
[17] In Salanié (2003), p. 3.
[18] See Grúň (2004), pp.47 - 48 for details.

could mention, *inter alia,* the educational system, social services and even architecture or arts.

The growing state sector had an implication that the taxes itself were not enough to cover the rising expenditures of the state budgets. Therefore, the monarch or the governments had to partialy finance the state expenditures by the credit loans. These loans had different forms (e.g. from commercial banks), but evidently it led to the birth of national debt phenomenon.

We can summarize by saying that the state sector was growing and consequently the state revenue were consolidated in order to ensure the financial resources for the rising requirements of the state budgets. However, more frequently the state revenue from taxes and fees were not able to cover the rising expenditures and states became indebted.


# *1.4  Modern period*

The taxation system was influenced and shaped by the thinkers of that era. Adam Smith, David Ricardo and others[19] did support the formation of liberalism and minor state intervention to the process of the economy. The liberal ideas influenced mainly the dominance of the free trade and thus the custom duties were cut rapidly. Therefore there was an attempt to restrcit the tax collection solely for the inside and outside security and for the purposes of law and order.[20]

Despite of the fact that the liberal ideas were extending, the state sector was rather growing than diminishing. That was due to the fact that mainly the military expenditures were rising (new technologies, management and administration of colonies and discovering of new colonies), also administration and expenditures on police, courts and social benefits were increasing. Further we cannot forget that most of the states were indebted as was explained above and they had to service their debt.[21]

The tax systems started to be **compact** and they began to play fundamental role in the economy. Balances of revenue and expenditures of state budgets were annually compounded and gradually they became analogous to the state budgets as we know them from the present.

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[19] See e.g. Screpanti & Zamagni (1993), pp. 54-118 for their detailed ideas, for other and for further references.
[20] In Grúň (2004), p. 63.
[21] See Grúň (2004), p.64 for details.

Taxes were already distinguished on direct and indirect. And almost every tax was paid in monetary units. We should mention that the public sector still constituted only less than 10 percent of national income in most of the European countries and even less than 5 percent of national income in the U.S. in the end of 19th century.[22]

## 1.4.A Reasons of Rapid Increase of the Public Sector in the 20th Century

In the 20th century the public sector grew rapidly and we should now focus on the reasons of this rapid increase.[23] The first reason is the strong and permanent increase of social expenditures which laid the foundation of the modern welfare state as we know it from most developed countries in present period. The origin of the welfare state dates back to the 1883 to Prussia, when the compulsory health insurance was introduced. Only after six years also the pension system in Prussia was created. Other countries followed this suit mainly in the beggining of the 20th century.[24] We could have witnessed also the birth of unemployment benefits in this time period.

Secondly, most of the European countries as well as the U.S. were involved in two main war conflicts in the 20th century. Two world wars did increase the military expenditures dramatically. Even between those two war conflicts the size of public sector did not reduce much.[25]

In the countries which were directly involved in the war, expenditures on military purposes reached or even passed the half of the national income. Some of these skyrocketing expenditures were financed by borrowing, but most of them were covered by the tax increases. Therefore for example the top marginal rates of income taxes became even confiscatory above 90 percent in the United States and United Kingdom during the World War Two.[26] The question which would be address in this thesis is then straightforward – do these tax increases indeed increase the relevant tax revenue ?

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[22] In Salanié (2003), p. 3.

[23] These reasons are taken from historical and social point of view, for economic explanations of the growth of the public sector in developed economies in 20th century see next chapter where the economic reasons are elaborated more precisely.

[24] See Salanié (2003), p. 4. for exact dates of introduction of these social welfare benefits in different states.

[25] As reasons we can mention the birth of the welfare state in many countries, state funds were also needed for the reconstruction of destroyed regions and infrastructure etc.

[26] See Salanié (2003), p. 4.

## 1.4.B The Development after the World War Two

After the Second World War in many countries the state finances were used again for the reconstruction of destroyed areas. Moreover, the social contributions were consolidated, for example the Beveridge Report[27] helped to consolidate the welfare contributions in the United Kingdom.

The new tax called value-added tax (VAT) was introduced since 1954 in France. VAT was introduced in the European Communities (EC) in the late 1960's and it was intended to replace four types of sales or turnover taxes, which existed until then in different European countries.[28] This tax constitutes almost 20 % of tax collection in the European Union[29] in the present.[30]

As a reaction to the growing budget deficits and "stagflation" in the 1970's there were introduced fiscal reforms from right-wing governments. In some countries the top marginal rates of personal and corporate income taxes were dramatically reduced in order to support growth.[31] In the United States this reduction of top marginal rate fell during several years from 70 percent to 28 percent in year 1986.[32] In most of the European countries similar reforms took place, however they were more modest.

## 1.4.C Total Tax Revenue in Different Countries

In Table 1.1 you can find the development of tax revenue in chosen OECD countries since year 1955 to year 2005. From this table it is evident that the total tax burden varies across the developed countries rather considerably. According to the table there are countries, where the total tax revenue constitute almost one half of the GDP of the country (in Sweden it even exceeds one half). Contrariwise, there are countries where the total tax revenue do not reach one third of the GDP such as United States, Japan or Switzerland.

In the table there is also some evidence on the variation in time. However, we can see that the level of tax revenue was rather stable after the WW2 in many developed countries. In some countries there was rather gradual increase of the tax revenue such as in

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[27] See e.g. Angresano (1995) pp. 273-276 for detailed description of this report.
[28] See e.g. El-Agraa (2007), pp. 282-283 for more detailed description of these sales and turnover taxes
[29] The autor is aware of the differences between the EC and European Union (EU). Therefore the distinction is done in the text and to the terms is reffered usually separately.
[30] See e.g. European Commission (2008) for more detailed figures on VAT and its collection.
[31] See the discussion concerning the supply-side economics and mentioned references in chapter three.
[32] In Salanié (2003), p. 4.

United Kingdom, France or Switzerland. However, in Sweden the tax revenue more than doubled since 1955 and thus they rose rather rapidly up to 51,1% of GDP

**Table 1.1: Total Tax Revenue in Chosen OECD Countries**

| Total tax revenue as a percentage of GDP in chosen OECD countries | | | | | | |
|---|---|---|---|---|---|---|
| | 1955 | 1965 | 1975 | 1985 | 1995 | 2005 |
| France | n.a. | 34,5 | 35,5 | 42,4 | 42,9 | 44,3 |
| United Kingdom | 29,7 | 30,4 | 35,3 | 37,7 | 35 | 37,2 |
| Germany | 30,8 | 31,6 | 35,3 | 37,2 | 37,2 | 34,7 |
| Sweden | 25,5 | 35 | 41,6 | 47,8 | 48,1 | 51,1 |
| Switzerland | 19,2 | 17,5 | 24,5 | 26,1 | 27,8 | 30 |
| United States | 23,6 | 25 | 25,6 | 25,6 | 27,9 | 26,8 |
| Japan | 17,1 | 18,3 | 20,9 | 27,4 | 26,9 | 27,4 |
| OECD-total[33] | 24 | 25,8 | 29,7 | 32,9 | 35,1 | 36,2 |
| EU-15[32] | 26 | 27,8 | 32,4 | 37,7 | 39,2 | 39,7 |

Source: OECD (2006)
n.a. stands for not available.

## 1.4.D Closing Remarks

From this short excursion to the history of taxation it seems to be apparent that the legacy of the history has implications into the present. Thanks to the historical development countries do differ in the magnitude of taxes as well as in the structure of their tax systems.

Present development has also important implications for the tax systems. The environmental taxes are already part of the taxation system and their significance would be probably more apparent in the future. There are opinions which support the double dividend hypothesis. This hypothesis claims that the environmental taxation would not only contribute to the better environment but also reduce the costs of tax system.[34]

We should also mention the globalization of the world's economy. Therefore, the capital is more mobile and people and firms can vote with their feet.[35] According to this theory inhabitans and firms choose in which country to reside according to tax rates and levels of public goods. In theory this is possible, however in the practice there are some limitations and impediments in the migration of people and firms into different countries even within the

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[33] The unweighted averages were used, the EU 15 area countries are : Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal , Spain, Sweden and United Kingdom.
[34] See e.g. Goulder (1995) or Bovenberg (1999) for the description of different forms of double dividend hypothesis.
[35] See e.g. Mueller (2003) pp. 199-202 for detailed describtion of this theory and for empirical evidence.

European Union.[36] However, even this phenomenon of tax competition[37] contributed to the lowering of personal and corporate income taxes and mainly to their top marginal rates. This issue concerning the corporate income taxation would be discussed in greater detail in chapter five.

In the next chapter we will more closely explore different theories of taxation, the rationale for government interventions into the economy and the economic reasons for rather substansive size of the public sector in developed econoies. Moreover we will briefly comment basic properties of tax systems and tax efficiency.

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[36] As such impediments we can see different laguages, different norms and legal practises and also the fact that people in Europe do not migrate that much as in the United States.
[37] Tax competition is concept where regions or countries compete to attract firms and capital to settle down in their region or country and it would be partially discussed concerning the corporate income taxation in chapter six.

# 2    Introduction to the Theory of Taxation and Tax Systems

Taxes and taxation systems are present in the everyday life of all human beings and they affect our decisions concerning work and labor supply, savings, education, consumption, retirement etc. Also on the macroeconomic level taxes affect very broad spectrum of subjects from level and structure of investment to allocation of governmental resources into public goods and other services provided by the government. Tax policy may also reflect the elements of national culture and the values of society other than equity or individualism.

In this section we at first briefly review different theories of taxation, then we will focus on the reasons why the government intervenes and why the magnitude of the public sector is that sizable and varies accross the countries.

## 2.1  Different Theories of Taxation

During the time there evolved several tax theories which explain the creation and purpose of taxes and we should now investigate them more closely. Two main ones are the benefit theory of taxation and the ability to pay theory and we shortly review them. Among other theories we can classify economic surplus theory[38], utilitarism or ideas of Rawls or Nozick,[39] however we will not review them here.

### 2.1.A The Benefit Theory

According to its term this theory argues that each individual should contribute to the state system in accordance with the benefits he derives from the state. Taxes therefore should reflect the demand of individuals for public services (e.g. the protection, health service etc.).

The critiques of this theory claim that it requires to measure values which are hardly measurable and it is incompatible with social justice and fairness.[40] Thus this theory could be applied solely to some specific taxes, such as the fuel tax (consumption tax on fuels). The revenue from this tax should be used for developing of the quality of roads and highways,

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[38] See Trotman-Dickenson (1996), pp. 115 for detailed explanation.
[39] For detailed description of those theories and ideas as well as for further references see e.g. chapter three in Barr (2004), pp. 42-63.
[40] See e.g. Trotman-Dickenson (1996), pp. 115-117 for the discussion.

transportation services etc. Therefore there is visible link – those who pay the tax also receive benefits from this taxation.[41]

## 2.1.B Ability to Pay Theory

This theory is mostly recognized theory of taxation.[42] It tackles the problem of equity and social justice and it declares that individuals should contribute to the system according to their means. Hence those in need of state benefits do not have to according to this theory contribute to the system heavily.

As an example of the tax which would be explained by this theory we could mention for instance progressive income taxation. The taxpayers with lower income would pay lower taxes and the problem of social justice is therefore settled.[43]

## *2.2  The Rationale for State Intervention*

We have shortly reviewed theories of taxation which try to explain how the taxation was introduced and who should pay different taxes. Let us now focus on the reasons why taxes are needed and why the public sector engages from one third to over one half of the whole economies of the developed countries as we have seen in the previous section. At first we should focus on the roles of government and then we would investigate when the government (state) should intervene into the market.

## 2.2.A Roles of Government

According to Musgrave[44] the government has three functions on the field of economy[45] in the democratic society. With the **stabilization function** the government should should maintain stable prices and employment. This could be done by using the monetary and fiscal policy.

The **allocation function** should ensure that the goods and services are allocated in sufficient quantities for the consumers. That could be done through the market (state should solely supervise and enforce laws) or via government provisioning

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[41] See Voorhees (2005), pp. 90-91 for detailed discussion of these examples.
[42] See e.g. Trotman-Dickenson (1996), pp. 117-118.
[43] See Voorhees (2005), pp. 90-91 for details.
[44] Originally in Musgrave (1939), taken from Voorhees (2005) pp. 88-90.
[45] Note that these are not functions on the political field. There would evidently be different functions of the government.

The most discussed and controversial function is the **distribution of wealth**. The level of redistribution varies greatly among countries and it is highly connected to the notion of fairness and equity.

## 2.2.B Market Failures – Rationale for Government Activity

According to the two fundamental theorems of welfare economics the market provision of goods is superior than the public provision.[46] However the assumptions of those theorems are restrictive and if those assumptions are not satisfied the private market provision is not efficient. We should now focus exactly on those situations, when the market provision is not Pareto-efficient and when the state intervention should be necessary – those conditions when the governmental activity is rational are called **market failures**. Below we only shortly review the most known market failures.[47]

Several reasons in some industries could cause that there exist relatively few firms with a large share of the market. Therefore there has to be control of **abuse of dominant position** (regulation, state intervention), since these firms are more liable to that kind of unethical behaviour.

**Public Goods** are goods with special properties which ensure that their provision by the market would be insufficient or they would not be provided at all. Those properties are non-excludability and non-rivalry in consumption.[48] Typical examples which would ensure both of these properties are, *inter alia*, national defense of a country, lighthouse for ships on the sea or a system of justice.

Situations when the action of individual or a firm affects other individuals or firms and the latter are not compensated for that actions are called **externalities** (negative or positive). One of the most wide-spread solution to externalities is regulation or imposing penalties and fees (rewarding for positive externalities).

The literature mentions also **incomplete markets** (e.g. the market for loans and insurance) and **information faiures** as market failures.

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[46] See e.g. Stiglitz (2000), pp. 60-61.

[47] For more detailed description of market failures and their exercise in practise see e.g. Stiglitz (2000) pp. 76-86.

[48] Obviously those properties are usually not satisfied fully, therefore pure public goods are rare in the real world. Most of the public goods have characteristics of non-rivalry and non-excludability to some degree and they are called impure public goods. See Trogen (2005) pp.169-205 for full characteristics of impure public goods and other specifications such as excludable public good or congestible public good (the assumption of non-rivality is violated).

## 2.2.C Another State Interventions

The state involvement in the situation of **merit goods** is based on the assumption that the individual may not act in his own best interest, even if he has all the necesarry information. The typical merit goods where the state involvement urges individuals to consume them are seat belts in the cars or elementary compulsory education.[49]

**Redistribution** of income to the needy or we could use the term **equity** is another situation when the government intervenes and thus uses taxes. There are two types of equity – horizontal and vertical equity. The former one is rather easily accepted and requires that there should be equal treatment of those who are in all relevant aspects the same. These relevant aspects could be understood as gender, age, ethnical or religious conviction etc. In majority of cases this horizontal equity is satisfied across developed countries.

However vertical equity is much more complex and complicated issue which depends mainly on the normative perception to what extend the redistribution should take place. It is essential to claim that the state involvement in such situations is not approved by everyone and it depends on the normative judgements of each individual.

## 2.3 *The Size of the Government*

As it was mentined in the previous section, the size of the government grew significantly throughout $20^{th}$ century in developed and also in most of the developing countries. In Figure 2.1 you can see total tax revenue as a percentage of GDP for OECD countries in years 2000 and 2006. Remeber also the Table 1.1 from previous chapter. Note that on average the size of the public sector which could be approximated by the total tax revenue[50] exceeds 35% in OECD countries and it could extend even beyond 50% level.

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[49] In Stiglitz (2000), p. 87.
[50] Evidently this is sort of simplification, since government has certain other tools how to obtain additional revenue (e.g. budget deficit, seignorage etc.) and thus the size of public sector could be greater or minor.

**Figure 2.1: Total Tax Revenue as % of GDP**
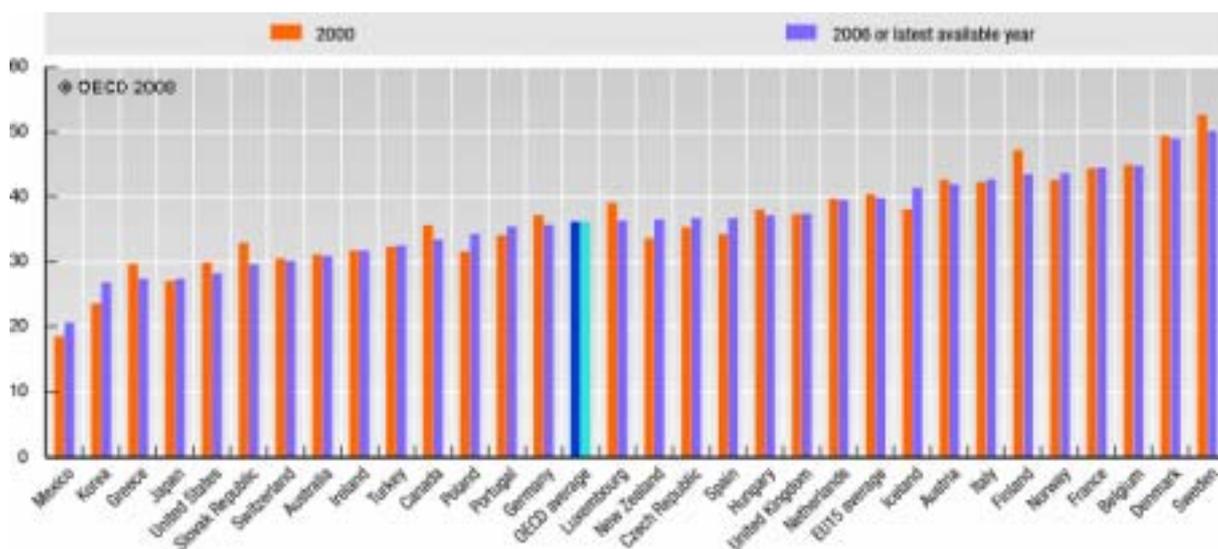


Source: OECD (2008)

Since the previous chapter focused mainly on political and social reasons for the size of the government and its growth in the 20th century we should explore the economic reasons and explanations of such a growth.

The pattern of the growth was evident in the first half of the 20th century and after the World War II, since 1970's the pattern has been much more varied. Countries such as United States, Belgium, Netherlands and Italy experienced decline in the share of government consumption in GDP. On the other hand, Austria, Finland, France, Norway, Portugal and other countries experienced the opposite and the share of government consumption in GDP has grown significantly.[51]

To explain the size of the government in the developed countries the equation (1) could be used:[52]

$$\dot{g} = (\eta + 1)\dot{p} + (\delta - 1)\dot{y} + (\alpha - 1)(\eta + 1)\dot{N} + \delta\dot{k} + \phi\dot{m} \qquad (1)$$

where the variables with the dots represent the growth rate of the given variable.[53]

The explained variable g is the share of government spending in the agregate real output. Left-hand side explanatory variables: N stands for population size, p is the relative

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[51] See Borcherding et al. (2004), pp. 77-79 for detailed describtion of the above mentioned development and for exact figures or see Table 1.1 in this thesis.

[52] It was firstly derived and used in Borcherding (1977).

[53] More formally the notation should be $\dfrac{\partial x}{x}$, where x denotes particular variable.

price of government services (to all other goods), y stands for mean income, k is the ratio of median to mean income and m stands for a set of political control variables.

If we take a look on the parametrs, $\eta$ represents the price elasticity of demand for government consumption, $\alpha$ is the degree of publicness of the output of the government sector, $\delta$ represents the income elasticity of demand, $\phi$ is the set of elasticities for the effect of the various political controls on demand. This form is useful for estimating and discussing the effects of various variables on the real government size and its growth.[54] The vast literature evaluate the effects of those different variables on the size of the government sector and we will discuss those factors in more details.

## 2.3.A Income Effect and Wagner's Law

German economist Adolph Wagner, who lived mainly in the 19th century and on the beggining of the 20th century, has investigated the expanding state expenditures and he observed empirical regularities in the growth of public enterprises as individual economies develop. These regularities were not only in the absolute terms but also in the relative portion of the public sector to the whole economy – this relationship is thus called „Wagner's Law" or "Law of increasing state activity".[55] Thus we could regard the public sector services as some kind of luxury good, where its consumption rise with income of the particular country not only in absolute values but also in reative terms and thus the income elasticity of demand for government services would be higher than unity.

Wagner believed that the increasing expenditures are associated with traditional state activity such as defense and maintaining law and order as well as with the implementation of newer activities: more emphasis on the education, welfare services and incrasing use of government regulations.[56] Wagner stated that the growth of real income would strengthen the relative expansion of income-elastic cultural and welfare expenditures. These areas such as culture and education would be in general more efficiently produced by the public producers than by the private ones.[57] Wagner also noted that there has to be upper limit for the proportion of government growth, but he did not specify it exactly.[58]

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[54] In Borcherding et al. (2004), p. 80.
[55] In Peacock & Scott (2000), pp. 1-2.
[56] Originally in Wagner (1911), taken from Peacock & Scott (2000), pp. 2-3.
[57] In Henrekson (1993), p. 407.
[58] See Peacock & Scott (2000), p. 3.

## Review of Literature on Wagner's Law

There exist a vast literature which investigate the relation of economic development and the growth of public sector (government activities). Therefore we will mention only few of them and study whether these studies confirm Wagner's Law or reject it. We also have to keep in mind that different authors used different specifications of the model, they used different measures of government[59], most of them omit to include public utilities (enterprises)[60] and the usage of independent variables also differs among studies. Different problems in the econometric techniques may arise as well and they would be shortly discussed below.

Earlier studies[61] do mostly confirm the Wagner's Law on their chosen samples of countries and time periods. These studies estimated either $(\delta - 1)$ term as is specified in the equation (1) thus if this elasticity is significantly greater than 0, the hypothesis of Wagner's Law could be confirmed. Or the studies estimated directly the income elasticity $\delta$ in that case if this elasticity is significantly greater than 1, they confirmed Wagner's Law hypothesis.[62]

## Different Problems of Estimations

However, if we have a closer look on these studies which focused on time series rather than cross-section data, we discover that the problem of non-stationarity of the data arises. It means that one of the basic assumption of time-series analysis that all regressors are either deterministic or stationary random variables is violated.[63] In most earlier studies that assumption is not met and thus the standard OLS regression brings inconsistent estimates if the integrated dependent variable is not co-integrated with one of the regressors.[64] Therefore those studies which omitted the problem of non-stationarity brought spurious regressions, where there was high level of $R^2$ but very low Durbin-Watson statistics and the estimated coefficients are not efficient.[65]

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[59] From very narrow sence excluding transfers and defense expenditure to broad definitions where all expenditure are included. See Peacock & Scott (2000) p. 5. for the discussion about different inclusion of different definitions of government.

[60] See the critical discussion concerning these omissions and why it could have been actually beneficial for the authors regarding thein results in Peacock & Scott (2000), pp. 10-13.

[61] See e.g. Goffman & Mahar (1971) or Bird (1971).

[62] E.g. Bird (1971) examined four developed countries (Germany, Sweden, Japan and United Kingdom) and he found the income elasticity ranging from 1.02 to 3.90 in different subperiods. Thus he also confirmed the Wagner's Law.

[63] E.g. in Stock & Watson (1988), p. 165.

[64] In Henrekson (1993), p. 412.

[65] This phenomenon of spurious regression was at first recognized by Yule (1926) and elaborated by Granger & Newbold (1974) where several Monte Carlo simulations on spurious regressions were done.

To overcome this problem the recent studies test whether the time-series data are stationary or not.[66] When the individual series are non-stationary, the authors then usually test the joint cointegration of time series data. If the cointegration is present then it is possible to test Granger-causality.[67] Then ussually if it was found that income Granger-causes the size of the government, the Wagner's Law was confirmed in such situations. The results of these recent studies are not that convincing and the hypothesis of Wagner's Law is not always accepted. For example Henrekson[68] examined data for swedish economy for the period 1861-1990 and he found that the government spending and real income per capita are not cointegrated, although both these variables dramatically rose during that time period. Thus he concludes that the growth of public sector cannot be explained *per se* by the growth of real income.[69]

On the other hand, Chang in his study[70] explores three emerging economies (South Korea, Taiwan, Thailand) and three developed economies (USA, United Kingdom and Japan) on time-series data over the period 1951-1996. He estimates five different versions of Wagner's Law (different specifications of the model) and he concludes that, with exception of Thailand, there exist a long-run relationship between income and government spending for sample countires. Furthermore, in most cases for selected countries (again with exception of Thailand) Granger-causality confirmed the validity of Wagner's Law in these countries.

<div align="center">

**Reversed Causality ?**

</div>

In the recent literature the issue of reversed causality is also discussed and examined. These studies focus on the influence of the size of the government sector on the economic growth of a particular country. Most of the studies concluded that larger size of the government sector lowers economic growth.[71]

For the purpose of estimating the Wagner's Law it is important to emphasize that in a single equation model the income coefficient $(\delta - 1)$ could be overestimated, since it would capture the reversed causality as well. However, Borcherding et al. on their data set showed

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[66] That could be done using the unit root tests (Augmented Dickey-Fuller test (ADF) etc.) for the application of this tests in practice see section 6.2.A of this thesis.
[67] See Borcherding et al. (2004), pp. 82-83 for more detailed description of this approach. For the practical usage of this approach testing the Wagner's Law see e.g. Henrekson (1993) or Chang (2002).
[68] In Henrekson (1993).
[69] Ibid. pp. 412-413.
[70] In Chang (2002).
[71] See e.g. Fölster & Henrekson (1999) pp. 347-354 for the results of their regressions for the OECD countries.

on the system with growth equation added, that the results would not change dramatically.[72] Therefore they concluded that Wagner's Law is still valid even with the inclusion of the reversed causality and growth equation.

To summarize this discussion concerning Wagner's Law one have to be aware of the fact that earlier studies often did not include the problem of non-stationarity of the data and thus estimates of these regressions were inconsistent. Recent studies do not give that straightforward results on the confirmation of Wagner's Law. Another problems may arise with the specifications of the model as well as with the unclear causality as was described above. Despite those limitations and traps we still can conclude that the growth of the public sector in developed economies could be partially explained by the Wagner's Law.

## 2.3.B Baumol Effect

Baumol and Bowen in their book[73] and one year later Baumol[74] in his seminal paper focused on the productivity in different employments (sectors) and the productivity lag of some employments. The model introduced by Baumol was a model of two types of economic activities, one of them being technologically progressive in which innovations, capital accumulation, and large economies of scale all make for the cumulative rise in productivity and output per worker. On the other hand, the second group of economic activity allows only for sporadic productivity growth.[75] As an example of the second group Baumol states for example teaching or music live performance.

One of the conclusions of Baumol's model of unbalanced productivities was that while the productivity per worker relatively rises in one sector and wages rise in uniform pace in both sectors,[76] then relative costs in the nonprogressive sector must ineviteably rise.[77] In consecutive discussion the cost pressures in some sectors were thus called "**Baumol's cost disease**" and it was identified that most of the public sector employments would belong to the group of employments with productivity lag.[78]

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[72] See Borcherding et al (2004), pp. 92-95 for exact results of the estimation of the system of those two equations and for the discussion.

[73] In Baumol & Bowen (1967).

[74] In Baumol (1967).

[75] See Baumol (1967), pp. 415-416 for the assuptions of the model.

[76] That is due to the fact that if wages would rise only in one sector, the employees of the sector where wages do not rise would tend to leave their employment and move to the sector with rising wages and new equilibrium wages would be determined.

[77] In Baumol (1967), pp. 419-420.

[78] The examples could be schooling, health care, police, state bureaucracy etc. which are typically public sector employments.

In comparism to the private sector the productivity growth is thus expected to be lower in the public sector. Therefore the relative cost of output of public sector would rise in time to all other goods produced by private sector. In addition if the demand for government services is price inelastic[79] the rise in price of government services would thus result in only relatively small decrease in the demand for the government services. Therefore the aggregate **expenditure on public sector would rise in time** due to this fact. Baumol effect is rather accepted in the literature and there are studies which confirm this effect of inelastic demand for government services on the growth of public sector and we would shortly review some of them.

### Empirical Evidence for Baumol Effect

The first condition of the rise of relative cost of government services is confirmed for example by Ferris and West[80] on the U.S. data or by Borcherding et al.[81] on the data of twenty OECD countries. They found that from 1970 to 1997 the average annual relative rate of growth of price index of government services to the GDP deflator was 0.8 percent.

Then the necessary condition of Baumol effect to take place is the price inelastic demand for government services. In equation (1) this could be captured by $-1 < \eta < 0$ [82] thus making it $0 < (\eta + 1) < 1$. This relation concerning elasticity of demand for government services is also validated by the studies in literature. For example Deacon in his study[83] estimated the value of elasticities for different public expenditure cathegories on 50 years of data for the city of Seattle. The estimated values of price elasticities of demand ranged in most of the cathegories from -0.4 to -0.7 which would satisfy the condition of inelastic demand.

Borcherding et al.[84] found that for their sample of OECD countries the elasticity of demand for government services ($\eta$) is insignificantly different from zero and thus it confirms the hypothesis of **very price inelastic demand** for government services.

While we present these results, we have to be aware of the fact that this effect should be estimated with the system of equations (demand and supply equation) rather than with only demand equation. However, results with usage of simultaneous equations mostly confirm

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[79] That means that the price elasticity of demand for government services satisfies this condition $\left| \dfrac{\partial D_G}{\partial P_G} * \dfrac{P_G}{D_G} \right| < 1$, where $D_G$ is demand for government services and $P_G$ is their price.

[80] See Ferris & West (1999), p. 310 for the results.

[81] In Borcherding et al (2004), p. 102.

[82] That is due to the fact that price elasticity of demand is negative and is then mostly used in absolute terms.

[83] In Deacon (1973), on p. 190 could be found the results of the estimated elasticities for cathegories such as municipal courts, police, libraries etc.

[84] In Borcherding et al (2004), p. 87.

those results mentioned above.[85] Thus we can conclude that size of the public sector and its rise in the last century could be partialy explained by the Baumol effect.

## 2.3.C Median Voter Theory

In the theory of public choice we can find another explanation for the size and the growth of the public sector. It concerns the voting and electoral rules as well as the redistribution of governmental revenue among people and inequality of income. According to Persson and Tabellini[86] the pure majority rule is defined by these three assumptions: direct democracy, sincere voting and open agenda.

If in addition we put another restrictions such as that the preferences of individuals are single-peaked[87] and we are in one-dimensional issue we get a Condorcet winner[88] coinciding with median-ranked bliss point. Obviously these restrictions are very limiting and there are plenty of situations when the assumptions are violated and the median position does not have to be decisive.

### Violation of Assumptions

The assumption of single-peaked preferences could be violated easily[89] and then this voting could lead into cycles as was firstly recognized by Marquis de Condorcet in 1785. It was also proved[90] that if the preferences are not singe-peaked then with the majority voting rule the person responsible for the agenda setting (the open agenda condition is also violated) could lead the outcome of the voting to any point in the issue space he chooses. This could lead to unpredictable results and it brings incentive to manipulate the process of voting to the advantage of certain person or group. Moreover, voting is ussually based on a multi-dimensional issue. However, in that case there also exist situations which ensure that the equilibrium point under majority rule will be median in all directions.[91]

If we relax the condition of direct democracy and we have a closer look on the case of representative democracy the situation gets far more complicated. In the bi-party political system the median voter position is more likely to be decisive. If we focus on the multi-party

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[85] Ibid., p. 81.
[86] In Persson and Tabellini (2000) pp. 21.
[87] Or equivalently if the utilities af individuals are quasiconcave.
[88] Condorcet winner is defined as that kind of policy which cannot be outvoted in any pairwise comparism – see e.g. Mueller (2003), pp. 147-150 for detailed elaboration of this condition.
[89] Individual could prefer no provision of that particular public good (e.g. education) to little provision, but from certain level he would prefer more provision of that good to no provision.
[90] See McKelvey (1976) for the proof.
[91] See Mueller (2003) pp.87-93.

system , the position of the median voter is weaker and does not have to be decisive. However if the entry costs for a new political party to enter the political competition are high enough, and other assumptions hold, the median position cas still be decisive.[92]

From this short analysis it is straightforward that the median position of a voter is very important and political parties give attention to the requirements of the median voter in order to increase the probability of winning the election. Thus if median voter is decisive or at least important for the policy implementation, the tax rates and accordingly the level of redistribution are to some extend set in accordance with the median voter position.

### Inequality of Income and Median Voter

In most of the economies the income distribution is skewed to the right and thus the median position is below the mean income position ($y^M \prec \overline{y}$).[93] This implies **relative redistribution effect**: redistribution increases with the income inequality. From these findings we could conclude that the median voter favors higher level of redistribution and thus it influences the size of the government.

In our equation (1) the effect of inequality of median to mean income is explained by the variable k. The literature also examines these effects of median income and the ratio of mean to median income on the size of government. However, the results are not evident and the relationship is not confirmed each time. Meltzer and Richard,[94] *inter alia,* have developed their general equlibrium model and they showed that the size of government is determined by the welfare-maximizing choice of a decisive individual (in majority rule that would be the median voter). They also presented the supporting tests of median voter hypothesis on U.S. data.[95] Mueller and Murrell[96] in their sample of 24 OECD countries give some weak support for the above mentioned hypothesis. Thus the evidence in the literature does not have such strong support, however the growth of the public sector probably could be partially explained by this phenomenon.

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[92] See Feddersen et al. (1990) and their model of set of potential candidates choosing whether or not to enter the political contest in the presence of entry costs in a singledimensional space, they also mention limitation of this model and other assumptions made on pp. 1012-1014.
[93] See Atkinson et al. (1995) for confirmation of this fact in OECD countries.
[94] In Meltzer & Richard (1981).
[95] In Meltzer & Richard (1981), p. 923.
[96] In Mueller and Murrell (1986), pp. 134-135.

## 2.3.D Other Factors Influencing the Size of the Government

These factors that could influence the size of the government are captured by the set of political control variables – m in equation (1). Borcherding et al.[97] focus on two particular approaches how recent studies evaluate the influence of political control variables on the size of the public sector. We shortly review those approaches and comment them.

First approach is used to evaluate the role of the intrest groups and lobbying as well as the electoral rules. Some intrest groups may have an incentive to transform the size of the government and thus gain an additional support. Among those intrest groups we can find segments of population which are not really organized such as older or poor people. Example of more organized intrest groups could be the farmers or labor unions. We cannot forget the employees of the public sector – those people would mostly have an incentive to vote for larger government in order not to lose their employment.

Closely connected with issue of intrest groups is in the majority voting system trading with the votes – **logrolling.** In democratic societies and in the parliamentary bodies of democratic countries all around the world, the trading with votes is prohibited by law. However, on various issues the value of the vote differ for different people and politicans. Therefore, some might exchange the votes in issues they are not intrested and they might gain the support of their „trading partners" in more appealing issues for them. This will bring benefits to the traders, however it will lower the benefits of those, who did not particiapte in this horse-trading and as a consequence this can lower the welfare of a society as a whole and obviously increase the public expenditures. Logrolling therefore emphazise the role of lobbying and could lead to excessive governmental spending.[98]

### Second Approach

Second approach emphasizes changes in costs of raising funds for the government. Since the participation of woman and the urbanization of the working population has grown significantly over the last decades, the costs of raising funds for the government decreased. On the other hand, the rise of self-employed people had contradictory effect on these costs.

In the study of Borcherding et al. all those other factors were also found significant and thus they were evaluated to have an influence on the size of the government as well.[99]

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[97] In Borcherding et al. (2004), p. 85.
[98] See e.g. Tullock (1959) for the introduction to the discussion about logrolling.
[99] See Borcherding et al. (2004), pp. 87-91 for exact results of their regressions.

We have shortly explored the main determinants of the size and growth of public sector activities from the economic point of view. All these determinants have support in economic theory and in addition there are studies which empirically estimates and confirm their validity in different countries and on different data sets as was very briefly presented in this section. To conclude our discussion about taxation theories and tax systems we should shortly discuss the latter and explore determinants of different tax systems.

## *2.4 Properties of Tax Systems and Their Efficiency*

We have seen that the state sector needs funds to enable the interventions into the economy. These funds are evidently collected mainly from taxes and we should now focus on the tax systems and their efficiency.

The **tax systems** around the world are compound of a variety of different taxes. There are some taxes which are basically the same in different countries and teritories. On the other hand, there are certain specific features and differences for each country. We would solely mention the basic types of taxation and taxes and then we will focus on the issue of optimal taxation and tax systems.

In developed economies we could divide taxes into three broad cathegories which are[100]:

- **Direct taxation (taxes on income)** – mainly we can emphasis the income tax of individuals, corporate income tax, compulsory social security contributions etc.

- **Indirect taxation (taxes on consumption)** – into this group we can include taxes like value added tax (or any other sales tax), excise taxes, customs duties and usually also environmental taxation which is applied more and more often.

- **Taxes on capital** – among those we can incorporate for example capital gain tax or inheritance tax.

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[100] This division is based on Trotman-Dickenson (1996), pp. 125-126.

**Figure 2.2 – Income Taxes Revenue as % of GDP**
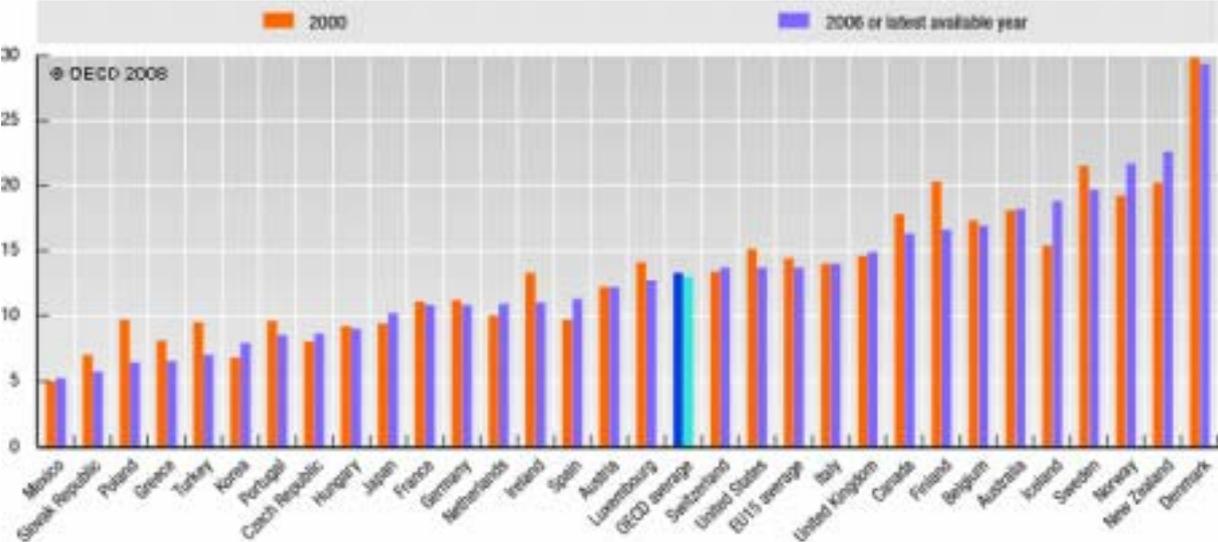


Source: OECD (2008).

Evidently there exist a vast number of other taxes which were not mentioned here and most of them should also fall into one of these three cathegories. In Figures 2.2 and 2.3 we can se taxes on income of individuals and corporations and taxes on goods and services as a percentage of GDP in OECD countries respectively for years 2000 and 2006. Note that the income taxation figure do not include social security contributions. It is straightforward that on average in OECD countries the income taxation is little more significant than the consumption taxation.

**Figure 2.3 – Consumption Taxes Revenue as % of GDP**
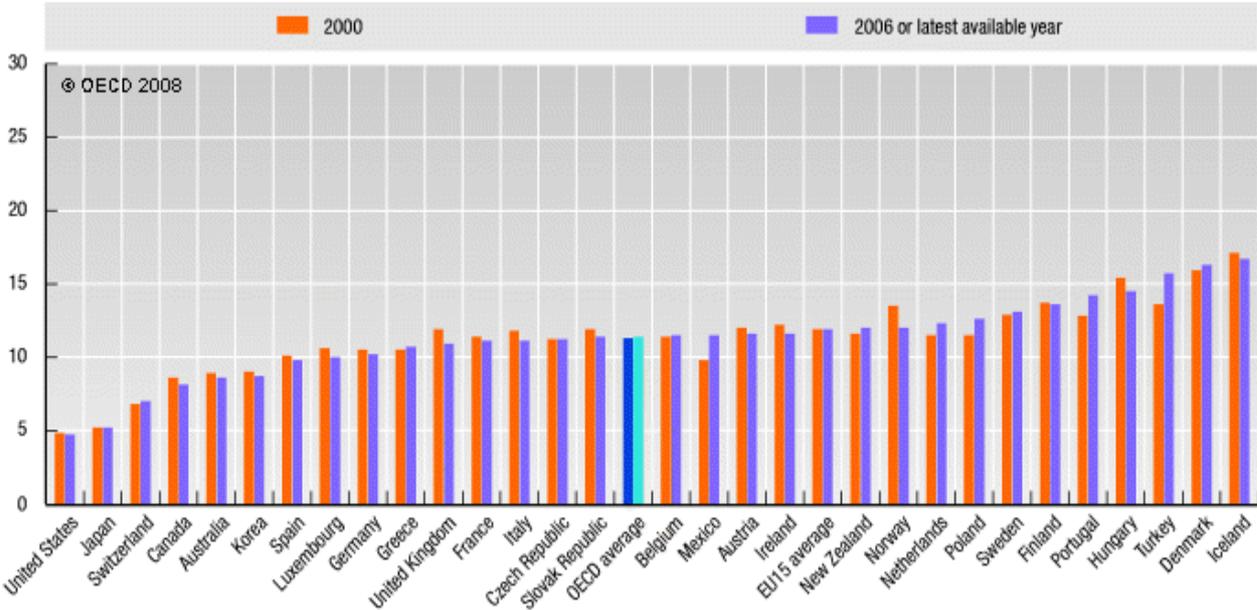


Soure: OECD (2008).

We will not concentrate more on various tax systems and their properties.[101]  Rather in the concluding part of this section we would focus on the issue of optimal taxation and on the recommendations on that issue stemming from the economic literature.

## 2.4.A Optimal Taxation

The issue of tax efficiency is higly discussed in the literature. By introducing taxes into the economy there is, in most cases, also introduced inefficiency which accompanies them.[102] The introduction of most of the taxes brings both income and substitution effect. The distortionary effect of taxes arise when they influence the optimal behaviour of economic subjects and that is caused due to the substitution effect. Therefore most of the taxes causes welfare losses (dead weight losses) and the taxes which should be most efficient should minimize those welfare losses and thus minimize the substitution effect.

The issue of optimal taxes was at first explored by Ramsey[103] and since then the topic was many times reviewed and complemented. Ramsey in his paper focused mainly on the commodity taxation. His results of the model implies to have taxation with least distortionary effect we need different commodities tax at different tax rates depending on the elasticities of demand and supply for those commodities. Thus the commodities with less elastic demand should be taxed more and that would cause the substitution effect to be minimized.[104] Obviously these results do not take into account the redistribution issue as well as administrative and political costs of this setting.[105]

### Income Taxation and Broader Perspective

The theory of optimal income taxation was elaborated for example by British economist James Mirrlees. To put it very briefly he came with the thought that is sometimes reffered as Mirrlees solution.[106] He argued that the progressive system with different bands and tax rates is very inefficient and the tax revenue from its introduction are not that high. He proposed the

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[101] For extended discussion see e.g. Trotman-Dickenson (1996), pp. 125-134.

[102] If we take into account the taxation of negative externalities, then there is on the other hand the rise of efficiency present since the negative externality is diminished. Another tax which does not introduce inefficiency into the system is uniform flat tax for everyone (poll tax). The budget constrain of everyone is thus lowered, but this tax does not influence the behaviour of economic agents, the substitution effect is not present and thus it does not bring inefficiencies into the system. On the other hand, these taxes are in controversy with vertical equity and the issue of redistribution.

[103] In Ramsey (1927).

[104] See Ramsey (1927), pp. 58-60 for implications of his model.

[105] See Holcombe (2004), pp.144-145 for further discussion about efficient commodity taxation and inclusion of administrative and political costs.

[106] See Mirrlees (1971) for detailed information about his model and the way he derived to the presented results.

tax system which would be linear (flat tax rate) with one exeption and that is the person (company) who earns the most in the society.

This person (company) would have, on the contrary with the system of progressive taxation, a tax benefit. He would have a lower tax rate than the others or even zero tax rate. That would acctually stimulate others for higher economic activity and it would be like a competition to reach the first place and have more beneficial tax rate. The budgetary revenue would not suffer because higher economic activity of others would create more tax base and therefore it would, according to the theory, mean more revenue for the budget, eventhough the person with highest income will contribute less to the system.

The theory of optimal taxation is further investegated for example by Joel Slemrod.[107] In his paper he focused on the issue of optimal taxation from broader perspective adding more features and making the issue complex. He concludes that although in theory the optimal taxation was described, it is difficult to implement them in practice. Thus to the theory the administrative and political costs should be incorporated and also more complex analysis should be implemented.

## 2.4.B Efficient Tax Systems

As was discussed above the tax systems are compound of various taxes, which need to be collected to provide funds for the government interventions and actions. Since the redistribution issue plays important role in creating taxes and setting their rates, the efficiency issue of particular taxes is in general less fundamental for policymakers. However there are some generally accepted properties which an efficient tax system should satisfy. Among five generally accepted properties of efficient tax system we can find economic efficiency, administrative simplicity, flexibility, political responsibility and fairness [108]

These properties are generally accepted, although current tax systems do not perfectly reflect them. Probably most discussed is the interpretation of fairnesss. As was mentioned above, the controversy stems from different perceptions of vertical equity. Thus while certain level of redistribution could be understand as fair for particular group of individuals, it could be perceived as extremely unfair for different group of individuals.

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[107] See Slemrod (1990) for detailed discussion.
[108] For details see e.g. Stiglitz (2000) pp. 456-469, or originally Musgrave (1959).

**Reducing Political Costs**

Other properties are not that discussed in the literature, however tax systems significantly differ in reflecting them. Some politicans in particular countries pay more attention to these properties, however in other countries the tax systems are considerably complex, not very transparent and thus the flexibility of a tax system is limited to a great extend as well. These deviations from the properties of efficient tax systems are caused by several reasons. We can mention, *inter alia*, the influence of intrest groups and their rent-seeking behaviour, logrolling, political process[109] etc. Since the tax systems are produced by the political process they could deviate a lot from the optimal tax structures.[110]

To prevent or at least considerably reduce the political costs the discussion about fiscal policy of government and setting the tax rates, level of redistribution, size of government services and public deficit etc. is in progress. For example Buchanan proposes the creation of fiscal constitution which sets the basic rules for tax structures and which could be modified only with substantial concensus.[111]

This would result into considerably more difficult situation for lobby groups to change the tax system and thus rent-seeking would be reduced as well as political costs associated with that.[112]

## 2.4.C Concluding Remarks

More detailed and further discussion about the efficiency of taxes and tax systems is above the scope of this thesis. However even from this short excursion into this problem it is straightforward that tax systems in present times do differ a lot among countries, are complex, complicated, do include administrative and political costs and at least to some extend do not reflect the recommendations from the literature. Thus they are more inefficient and produce considerable welfare losses.

In the next chapters we will concentrate on the main topic of this thesis – the Laffer curve. At first we would examine the theory behind Laffer curve and the empirical evidence

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[109] By this the author means various political failures arising from real political systems such as compromises that have to be made in order to at least partially satisfy other players in the political environment, the political terms and the desire of politicans to be reelected to the office etc.
[110] See the discussion in Buchanan (1975).
[111] See Buchanan (1987), mainly his chapter 18 (pp. 267-280) called Fiscal Policy Constitutionally Considered for further discussion and his detailed proposals.
[112] In Holcombe (2004), p. 143.

for that phenomenon in the literature. Then we focus on Laffer curve for corporate income taxation and present our models.

# 3     Laffer Curve Theory

As we have seen in previous chapters the state sector was rising significantly in last century. Evidently the government needs more resources to be able to finance its growing activities. Therefore it is appropriate to examine the relationship between tax rates and tax revenue and see whether it is possible at all times to increase the tax rates in order to increase corresponding tax revenue. The Laffer curve tries to give some solutions to this problem and considers the relationship between tax rates and revenue to be nonlinear. At first we would examine some theory behind the Laffer curve, then we would explore the literature concerning this topic. In the following chapter we will provide some estimates of Laffer curve and Laffer effects.

## 3.1  The Theory Behind the Laffer Curve

The concept of nonlinear relationship between the tax rate and tax revenue of government is well-known and was described several times in the history prior to Arthur Laffer explanation. Let us shortly review some of those thoughts on the relationship of tax rate on revenue from that particular tax before we review the introduction to the theory.

### 3.1.A Review of Thoughts

In 14th century the Muslim phiposopher Ibn Khaldum wrote:

*It should be known that at the beginning of the dynasty taxation yields a large revenue from small assessments. At the end of the dynasty taxation yields a small revenue from large assessments.*[113]

Another remark was made in the parliament of the United States. The then politican Edmund Burke in 1774 argued against overtaxation of the American colonists by saying:

*Your scheme yields no revenue. It yields nothing but discontent, disorder, disobedience, and such is the state of America, that after wading up to your eyes in blood, you could only end*

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[113] That originally appeared in: Khaldum: The Muqqadimah, the quote was taken from Laffer (2004), pp. 1-2.

*just where you began; that is, to tax where no revenue is to be found ...*[114]

We cannot forget on the legacy of Adam Smith, who in his seminal work wrote on the issue of commodity tax (sales tax in the United States):

*High taxes, sometimes by diminishing consumption of the taxed commodities and sometimes by encouraging smuggling, frequently afford a smaller revenue to government than what might be drawn from moderate taxes.*"[115]

Another known economist Jean-Baptiste Say was concern with high taxes and their influence on the revenue by shifting output. Ho wrote:

*Taxation, pushed to the extreme, has the lamentable effect of impoverishing the individual, without enriching the state... The diminution of the demand must be followed by diminution of the supply of production; and, consequently, of the articles liable to taxation. Thus the taxpayer is abridged of his enjoyments, the producer of his profits, and the public exchequer of its receipts.*[116]

In 1844 academic Dupuit described the relationship rather accurately by saying:

*If a tax is gradually increased from zero up to the point where it becomes prohibitive, its yield is at first nil, then increases by small stages until it reaches a maximum, after which it gradually declines until it becomes zero again.*[117]

We cannot forget to mention Austrian economist Ludwig von Mises who also perceived the threat of high taxes on revenue:

*The true crux of the taxation issue is to be seen in the paradox that the more tax increase, the more they undermine the market economy and concomitantly the system of taxation itself...*

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[114] This quotation taken from Blinder (1981), p. 83.
[115] Originally in Smith (1776), p.78; the quote taken from Yu Hsing (1996), pp. 395-396.
[116] Originally in Say (1834), pp.453-454; the partial quotation was taken from Barlett (2003), p.3.
[117] This quotation taken from Atkinson & Stern (1981), p.43.

*Every specific tax, as well as a nation's whole tax system, becomes self-defeating above a certain height of rates.*[118]

Thus you can see that the relationship was described several times in the history. However, the trade-off between tax rates and tax revenue received its name after professor Arthur Laffer. He used this relatioship in his classes and he illustrated it in December 1974 on a dinner with the then professor at the University of Chicago – Jude Wanniski, chief of staff to president Gerald Ford - Donald Rumsfeld, and Dick Cheyney deputy of Rumsfeld at that time. According to Wanniski[119] at Two Continents Restaurant at the Washington hotel at Washington D.C. this gathering was discussing proposals for tax increases by president Ford named as „WIN" (Whip Inflation Now). During this discussion Artur Laffer is said to outlined the curve illustrading the trade-off between tax rates and tax revenue on his napkin.[120]

Thus the trade-off was named by Wanniski the Laffer curve on the basis of this occurence and since then the Laffer curve is used and known term for the relationship between tax rates and tax revenue.

## 3.1.B The Theory

According to Laffer the basic idea behind the relationship between tax rates and tax revenue would be that change in the tax rate is associated by two effects on revenue: the **arithmetic effect** (tax rate effect) and the **economic effect** (quantity effect).[121] The arithmetic effect is straightforward and it states that with decrease of the tax rate the tax revenue would decrease by the relative amount of the decrase in the rate for the same tax base. This effect would obviously hold *vice versa*.

However, the economic effect goes in the opposite direction to arithmetic effect. The economic effect affects the tax base and if the tax rate is reduced than the tax base could acctually increase and thus the tax revenue would increase due to this effect. The overall effect of the revenue thus depends on the prevalence of one of those two effects.

The presence of these two effects implies that there exist two tax rates that will collect the same amount of revenue[122] – high tax rate in the prohibitive area on a small tax

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[118] In Mises (1949), p.734.
[119] See Wanniski (1978).
[120] Although Laffer itself is not aware of the fact that he would use the napkin for the illustration – see Laffer (2004), p.1.
[121] In Laffer (2004), pp. 2-3, the terms tax rate effect and quantity effect were used in Becsi (2000).
[122] Obviously except the revenue-maximizing tax rate, which should be an unique tax rate.

base and a low tax rate on a large tax base as you can see in Figure 3.1, where the basic Laffer curve is depicted.

**Figure 3.1: The Laffer Curve**
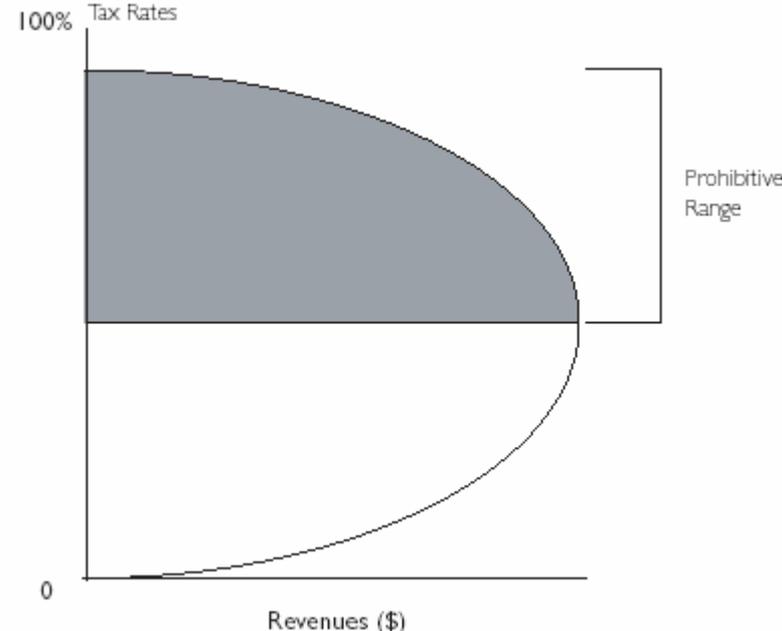


Source: Laffer (2004)

## 3.1.C Laffer Curve for Different Taxes[123]

Obviously the reasons for economic effect differ for particular taxes. **For personal income tax** the lower tax rate would have direct impact on supply of work, employment and indirectly it would influence the output of a given country and thus stimulate the tax base. Therefore these two opposite effects operate against each other and imply the Laffer curve relationship. For the income taxation if the tax rate is zero the government would collect no tax revenue, irrespective the size of the tax base. The other extreme would be 100% income tax which would most probably also generate zero government revenue.[124]

For explanation of the **Laffer effect in indirect taxation** (VAT, sales tax, excise duties) we can use the Figure 3.2. On the left-hand side picture you can see traditional picture of linear supply and demand for certain good, where at equilibrium point A there is no tax and thus Q* is the quantity produced and correspondingly there would be unique price (P*).

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[123] The effects for corporate income tax would be in detail described in the following chapter.
[124] Here we abstract from the fact that some people could have positive utility solely from working and thus they would supply some hours of work although they would not receive any wage from it. However, economic models of labor supply also ussually expect only disutility from working and thus approve our abstraction. Also if the tax rate would go beyond the 100%, there must be some higher tax rate that will eventually make him stop (see Laffer (1980)).

However with the introduction of taxes the quantity of good produced decreases (denoted Q\*\*) and the price including tax increases (denoted P\*\*). The price suppliers receive is denoted by P\*\*-T. Taken as an example the tax $T_2$ it is simple to derive that government revenue would be the area of rectangle $BXP_2**P_2**-T_2$ and for $T_3$ and $T_4$ correspondingly. The triangle ABX is the welfare loss (dead-weight loss) caused by the introduction of the $T_2$ tax.

**Figure 3.2: Derivation of the Laffer Curve for Indirect Taxation**
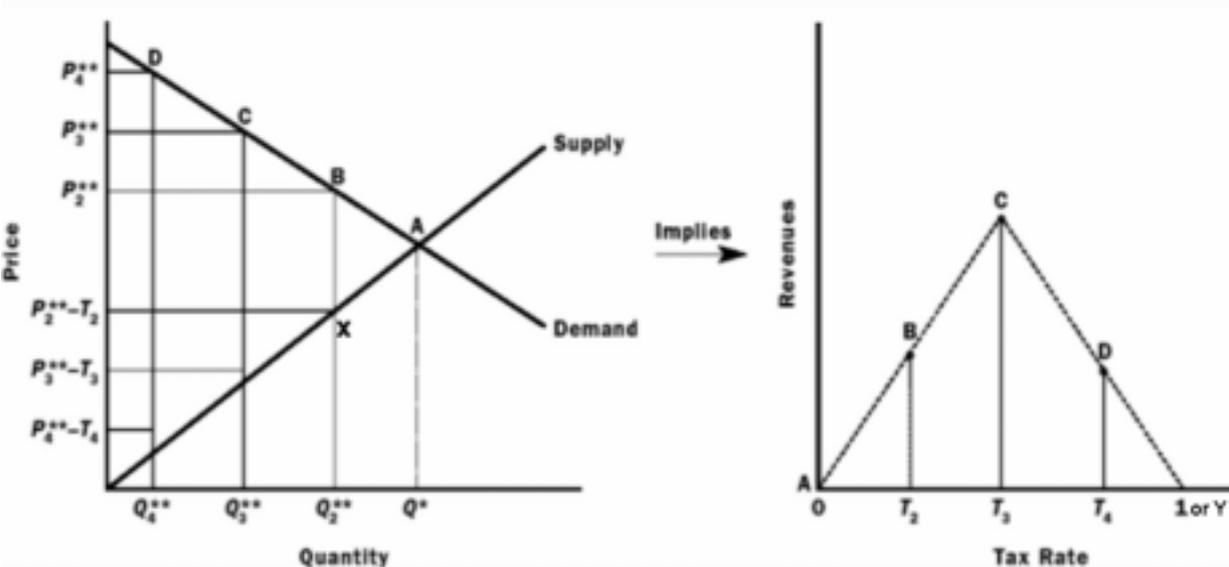


Source: Becsi (2000)

The right-hand side picture is the derivation of Laffer curve for this setting. It is evident that the government revenue at point A with 0 tax would be zero. Then they will gradually rise up to the point C (where $T_2$ is exercised) and from that revenue-maximazing point the revenue would decrease to the point 1 (the tax rate T =100%) or rather to the point Y, where the tax rate T could even approach infinity for the indirect taxation. In the case of indirect taxation the tax rate grater than 100% is not unfeasible and as was mentioned by Blinder for example excise taxes exceeded the rate of 100% many times and places.[125]

Obviously this is very simple setting, where the supply and demand curves are linear and well-behaved, however even from this simple setting we can see the logic behind the Laffer curve for indirect taxation.

Evidently the Laffer Curve does not give a clear solution whether for example a tax cut would result into rise or decline in revenue. Their response would depend upon the existing tax rate, tax system, time period, the ease of evasion of that particular tax, prevalence

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[125] In Blinder (1981), p.82.

of legal tax loopholes etc.[126] Also the revenue-maximizing tax rate does not need to be in the middle (constituing the rate of 50%) and further in the text we will see the estimates of that rate for particular taxes.

## 3.1.D Mathematic Rationale

To see that the Laffer curve has evidently the mathematical rationale as well we can use the Rolle's Theorem which is as follows:

*If a real-valued function f is continuous on a closed interval [a,b], differentiable on the open interval (a,b), and f(a) = f(b), then there is some real number c in the open interval (a,b) such that $f'(c) = 0$.*[127]

According to the theory we reviewed, we can substitute for $(a;b)=(0;1)$ for personal and corporate income taxation and $(0;Y)$, where Y could reach infinity for the indirect taxation. Thus the functional values would be $f(a) = f(b)=0$. Therefore if the assumptions of the Rolle's Theorem are satisfied we would derive the Laffer curve. Most of the authors do not doubt the continuity of Laffer curve, however as you would see later in the text the continuity was also challanged

## 3.1.E Revenue-Maximizing Tax Rate

We have seen the economic and mathematic rationale for the Laffer curve and we derived the basic shape of this curve. For our further discussion it is important to focus on the shape of the Laffer curve and the revenue-maximizing tax rate, which is depicted by $T_3$ at the Figure 3.2. In our models we would examine whether the relationship between tax rate and tax revenue for corporate income tax does confirm the bell-shape of Laffer curve.

If the shape is confirmed we would focus on the revenue-maximizing tax rate and try to estimate it. The importance of this rate reside in the fact that the area behind the maximizing tax rate as is a prohibitive (unefficient) area. As could be derived from Figure 3.2 as the tax rate rises, the dead-weight loss of the tax increases and since the optimal taxation framework declares that the dead-weight loss should be minimized, the desired tax rate should

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[126] In Laffer (2004), p.3.
[127] For the proof of this theorem see e.g. Hájková et al. (2000), p.80.

lie on the upside of the Laffer curve.[128] Thus the government should establish such a rate which lies on the upside of the Laffer curve (or at the top as the revenue-maximizing tax rate).

Tax rate exceeding the revenue-maximizing tax rate is irrationally high and could be replaced by lower tax rate which would generate the same government revenue with less dead-weight loss.[129] The main question thus would be what is the level of the revenue-maximizing tax rate and whether there are some countries which exercise greater tax rate, which is inefficient. One of the reasons why this is possible is explained in the next section.

### 3.1.F Supply-Side Economics

The Laffer curve relationship of tax rates and corresponding tax revenue is one of the major "product" of the supply-side economics. The most known representatives of this economic stream were Robert Mundell, Arthur Laffer, Jude Wanniski and others.[130] In this thesis we wil not evaluate the supply-side economics as such, nor their other findings. We would use positive approach to try to estimate and evaluate whether the concept of Laffer curve for corporate income taxation is present and see whether we can derive some conclusions according the height of the corporate income tax rates. However, at first in the rest of this chapter we will further explore the references about the Laffer curve phenomenon in the literature.

## *3.2  Thoughts on the Laffer Curve*

In the following chapter we will review the estimates of the Laffer phenomenon for different taxes in the literature. Before that we would focus generally on thoughts on Laffer curve which were made in the literature.

Buchanan and Lee in their paper[131] try to give explanation why it is possible to encounter the **tax rates exceeding the revenue-maximizing tax rates** in the reality. They also show why political decision makers may find it difficult to escape from that position. Among others they assume the politicans to be revenue maximizing.[132] Their crutial

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[128] In Blinder (1981), pp. 81-82, this assumes the fact that the lump-sum tax with no dead-weight loss is not possible.

[129] Here we do abstract from the taxation of negative extarnalities, which could lead to the optimal provision of some good or service with higher tax rate.

[130] See e.g. Barlett (2003)  for more thorough elaboration of this stream in economics and also for the references to its critiques.

[131] In Buchanan & Lee (1982).

[132] However this is not that crutial assumption and it is weakend in Buchanan & Lee (1981).

assumption is that government applies a higher than market discount rate to future tax revenue. In particular it is assumed that the political time horizon is shorter than the period of time necessary for complete private sector response to a tax rate change.[133]

Government (or more precisely the political decision makers) is assumed to be short-lived and thus preffering in short-run more revenue. Therefore they face the short-run Laffer curve and their optimal tax rate is set as revenue-maximizing on the short-run Laffer curve. However, this rate falls into the downward sloping (prohibitive) part of the long-run Laffer curve. The long-run is defined as the period sufficiently long to allow for full behavioral adjustment to each rate of tax on base.[134]

Thus the reduction in tax rate would reduce the revenue in short-run and increase them in irrelevant (for the government) long-run case. Therefore the authors argue that government would never operate on the down slope of the long-run Laffer curve.

The authors also discuss the issue when the expectations are introduced. Government and taxpayers would be better off if rates could be reduced and revenue increased. The government could increase the revenue only by convincing the taxpayers that rate cuts are permanent. However taxpayers in their setting do expect short-run maximizing behaviour of government and thus they do not expect these tax changes to be premanent. Thus both groups find themselves in a dillema which might be difficult to escape from.[135]

According to the authors mutual gains could be secured only if government can somehow bind itself through some sort of commitment to lower rates below equilibrium levels in the short-run model and to hold these rates.[136] As a solution they suggest introduction of some sort of genuinely constitutional ceilings and thus also reducing the policy costs as was discussed in chapter three.

## 3.2.A Shifty Laffer Curve

Another intresting remark about Laffer curve behaviour was made by Becsi in his paper.[137] He states that the shape of Laffer curve depends on the way how the tax revenue are

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[133] Buchanan & Lee (1982), p. 817.
[134] Ibid, pp. 817-818.
[135] This dillema could resemble to the dynamic inconsistency problem in monetary policy as was firstly described by Kydland & Prescot (1977). By discretionary policy and with rational (adaptive) expectations of people the equilibrium inflation is extremely high and is not accompanied by GDP growth. Thus monetary authority (central bank) is not successful in any of its goals and the equilibrium is not beneficial for any party as in our specification with tax rates and revenue. The literature gives several solutions to this problem which in general include some sort of monetary policy rules.
[136] In Buchanan & Lee (1982), p. 819.
[137] In Becsi (2000).

spent by the government and thus it is important to observe the expenditure policy of the government as well, in order to derive the actual Laffer curve. Becsi introduces a simple dynamic macroeconomic model[138] consisting of households, production and government sectors.[139] He studies the long-run effects of taxes and thus the attention is given to the steady-state equilibrium of the introduced model.

He evaluates the personal income taxes and three possible ways how the additional revenue would be spent by government in order to balance the budget. The lump-sum transfers back to the people have no long-run macroeconomic effect and thus they would not change the Laffer curve. On the other hand, if the share of public capital would be increased in order to balance the budget the Laffer curve will shift upwards and thus it would lie above the Laffer curve for lump-sum transfers. Also the revenue-maximizing income tax rate would be greater.

The last case considered is the increase of share of public consumption to balance the budget and the Laffer curve corresponding to the public consumption lies above both previous cases.[140] All three cases are depicted in Figure 3.3. Author therefore concludes that without the reference to the expenditure policy the possible effects on tax revenue may be miscalculated since wrong Laffer curve could be used.

**Figure 3.3: Shifty Laffer Curve**
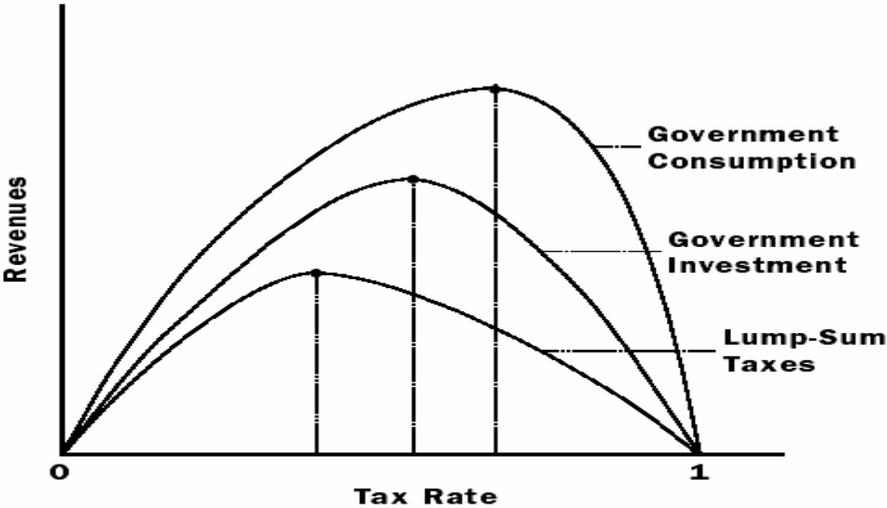


Source: Becsi (2000).

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[138] This model is based on Baxter & King (1995).
[139] The model *per se* is described in Becsi (2000), pp.56-58 and p. 63.
[140] See Becsi (2000), pp.60-62 for detailed discussion about the results of the model for those three possible cases.

Also in his other paper Becsi examines the way how government spends the collected revenue in order to balance the budget.[141] Contrary, the author uses static general equilibrium model and he again examines the personal income tax and thus the Laffer effects on this kind of taxation.[142] He concludes that if budget-balancing lump-sum transfers to people accompany the tax rate change and thus there are less provided public goods (or other goods provided by the government) the likelihood of Laffer efects increases.[143]

Therefore, this is similar conclusion as derived from his dynamic model. Although this is very intresting approach, we do not evaluate the expenditure policy of government in our model in next chapters for following reasons. The availability of data for government expenditures is limited, we also try to comply with parsimony of the econometric model. Not least Becsi's models are designed for the personal income tax, however we will deal with corporate income tax which has different features and the results of such model could thus differ.

## 3.2.B Multiple Peaks of the Laffer Curve

Another intresting finding regarding the shape of the Laffer curve was made by Spigel and Templeman.[144] In their paper authors examine the shape of the Laffer curve from personal income taxation on a micro level for individuals. Then they try to aggregate their findings and introduce the macro level Laffer curve as a vertical summation of individualistic Laffer curves of heterogeneous individuals in the society.

The authors claim that if certain assumptions hold[145] the macro level Laffer curve for the personal income tax is likely to have multiple (or at least dual) peaks, although the individual Laffer curves have only single peak. The authors derived the conditions under which the dual or multiple peak values of tax revenue are likely to occur. They conclude that these conditions reflecting the diversity of income distribution are present in the western

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[141] In Becsi (2002).

[142] See Becsi (2002), pp. 2-7 for the description of the static equilibrium model.

[143] In Becsi (2002), pp 11-12.

[144] In Spigel & Templeman (2004).

[145] These assumptions are as follows: the wage distribution demonstrates a very high degree of inequality and thus is one-tailed assymetric. Each individual who earns a given hourly wage rate has a peak point of tax payment at a given tax rate, which differs for different individuals. The individualistic supply curve of labor is at some point backward bending, thus from certain point therelationship between labor supply and the wage rate is negative (substitution effect starts to dominate). For detailed discussion of those assumptions see Spigel & Templeman (2004), pp. 61-62.

societies and thus the probability of personal income tax Laffer curve being mulitple peaked is high.[146]

Therefore it is possible that the change in the tax rate would have ambiguous effect on the tax revenue, which is not the case when the traditionally shaped Laffer curve is known. The authors also suggest that with this result the policymakers have different choices since the issue does not reflect simple fiscal question how to finance the government's budget. Rather the issue shifts to tax burden and thus it could be understood as to whom do the policymakers wish to impose the tax burden – the low income, the middle income or the high income group. Therefore the decision-making should cover also political, psychological, social issues and the issue of fairness.[147]

## 3.2.C Is the Laffer Curve Continuous Function ?

The fundamental condition of Laffer curve being a continuous function was examined by authors as Gahvari or Malcomson.[148] The latter in his paper introduces the general equilibrium model with one private and one public good, where he examines the personal income tax of identical individuals.[149] He concludes that even for well-behaved utility functions the Laffer curve may not be continuous and may have no interior maximum. Thus the author suggest determining the Laffer curve from empirical evidence and rather not from the theory.[150]

Gahvari went even further and he argued that the Laffer curve could have discountinuity at a tax rate equal one (100% ). Thus according to Gahvari the tax revenue from personal income taxation could continue to increase as tax rate increases as long as the tax rate remains below one.[151] In his setting for identical individuals, the income effect always dominates the substitution effect and thus consumption of leisure decreases and labor supply increases at any wage rate.[152]

Gahvari also showed in his other study in the model with identical individuals and two private goods (one of them could be produced by the government) that when the tax

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[146] In Spigel & Templeman (2004), p. 65.
[147] Ibid, pp. 65-66.
[148] We refer mainly to Gahvari (1988), Gahvari (1989) and Malcomson (1986).
[149] See Malcomson (1986), pp. 265-269 for the description of the used model.
[150] In Malcomson (1986), pp. 277-278.
[151] In Gahvari (1988), p.267.
[152] Ibid, pp 267-268. However if we evaluate the empirical labor supply we see that the individuals are different and the substitution effect at some wage rate starts to dominate and it makes the labor supply curve backward bending. For empirical evidence of backward bending labor supply see e.g. Link & Settle (1981) or Blundell & Meghir (1986).

revenue are used to provide a government good rather than cash transfers to consumers the discontinuity may be present and the Laffer curve may always be upward-sloping.[153] Thus he also claims that the shape of the Laffer curve depends on the way how government redistributes its revenue as Becsi does, however their results are different.

## 3.2.D Concluding Remarks

We have seen that the traditional shape of Laffer curve was challanged several times, however all of these articles referred rather to the personal income tax Laffer curve and did not consider the case of corporate income tax rates.

Also the modelling of those different shapes would be much more complicated and it even might not be testable.[154] Moreover, the traditional shape of the Laffer curve is now used in standard economic textbooks.[155]

Therefore, in the chapters concerning our model for corporate income tax Laffer curve our approach will be to implicitly expect the traditional shape of the Laffer curve and we would try to approve this shape or deny it. If we reject the traditional shape then we would discuss the other shapes as were proposed.

In the following chapter we will investigate the estimation of Laffer curve and Laffer effects in the literature.

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[153] In Gahvari (1989), pp. 251-252.
[154] See Heijman & van Ophem (2005), p.716, footnote 6.
[155] See e.g. Samuelson & Nordhaus (1995), pp. 795-797.

# 4 Review of Literature Concerning the Laffer Curve Estimation

In this chapter we would review the estimates of Laffer curve and revenue-maximizing tax rate as was done in the literature. We will not review all of the literature concerning this topic, however we would try to cover the most important ones. We will not focus solely on the econometric estimates, we would try to include also other estimates based on certain (static and dynamic) models or even real experiments and we would also mention the simple analysis based on macroeconomic facts.

Rather non-mathematic exploration of Laffer effects in three cases of american recent history was done by **Laffer** in his paper.[156] He examines the so called Harding-Coolidge tax cuts after WW1, where the top marginal personal income tax rate fell from 77% to 25% in 1925. Although tax revenue data for that period are not available, the author uses the total federal receipts as well as GDP and unemployment figures to illustrate the positive impact of those tax cuts.[157]

Top marginal income tax was cut by president Kennedy in year 1964 from 91% to 70%, and in the four years the total government income tax revenue increased by 9 percent annually.[158] Laffer also examines tax cuts made by president Reagan from 1981 to 1988, when apart other changes the highest marginal income tax rate was reduced from 70% up to 28%. The author suggest positive impact of these tax cuts on inflation, unemployment and also on the tax revenue, although these years were also stigmatized by large government budget deficits.[159]

## 4.1 Estimations Based on Equilibrium Models

In this section we will review the estimations of Laffer curve, Laffer effects and revenue-maximizing tax rate in equilibrum models. The static ones were used mainly in

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[156] In Laffer (2004).

[157] Ibid., pp. 4-5.

[158] Ibid, pp.5-7 where the Kennedy tax cuts are examined.

[159] The tax cuts done by Reagan are examined in Laffer (2004), pp. 7-10. These controversial impacts of Reagan's tax cuts brought various opinions regarding them. Some studies proposed that the tax cuts were not substantive enough due to the high inflation (McKenzie (1982)), others stressed the favourable impact of those tax cuts on work incentives and net GDP (see e.g. Feldstein (1986)), however critiques of these cuts were concerned with high budget deficits, which could have offset all the stimulative effect (see e.g. Akhatar & Harris (1992)).

1980's, more recent approach is to use dynamic models in order to capture the long-run effects of a tax change. We also review some country specific estimations.

## 4.1.A Static Models

**Canto, Joines and Laffer** in their paper[160] develop a static one-sector two-factor equilibrium model (production capital and labor) to analyze the effect of taxation on revenue. The taxes are assumed to be proportional on the incomes of factor of production.[161] With this setting they derived revenue-maximizing tax rate and concluded that the increase in the tax rate could increase as well as reduce government revenue, that all depends on the supply and output elasticities of the factors of production.[162] The authors then examined data on tax revenue and real per capita output before and after Kennedy tax cuts of 1962-1964[163], they conclude that these tax cuts had a positive impact on economic activity and there was no significant loss of revenue caused by them.[164]

**Blinder** in his paper[165] also confirms the theoretical existence of Laffer curve. However, he is sceptical that some broadly-based tax (personal or corporate income tax) would have passed the revenue-maximizing rate and would be in the prohibitive area.[166] When the author examines the flat income tax on labor (there is not general equilibrum approach) he derives that the tax rate which maximizes the revenue is equal to

$$t^* = \frac{\eta_S - \eta_D}{-\eta_D(1+\eta_S)}.\text{[167]}$$

Thus the elasticities have to be rather high in order to get revenue-maximizing tax rate lower than one (e.g. $(\eta_S; \eta_D) = (2; -2)$ in order to get $t^* = \frac{2}{3}$ ). Since these values of elasticities are empirically much lower, the author concludes that for broad-based tax rates the

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[160] In Canto et al. (1981).

[161] For detailed description of the used model and for the derivation of revenue–maximizing tax rates see Canto et al. (1981), pp. 4-17.

[162] See Canto et al. (1981), p. 13 for the exact formula for revenue-maximizing tax rates.

[163] See Canto et al. (1981), pp. 17-28 for empirical analysis of Kennedy tax cuts.

[164] Thus it would imply that before the tax cut some tax rates were in its prohibitive range and therefore the Laffer effect is confirmed.

[165] In Blinder (1981).

[166] Ibid, p. 84.

[167] Ibid, p.86, the $\eta_S$ stands for income elasticity of labor supply and $\eta_D$ represents income elasticity of labor demand.

revenue-maximizing tax rate is very likely to be high and thus it is unlikely that the tax rate would be in its prohibitive area.[168]

In other part of his paper the author uses the revenue-maximizing tax rates derived from the equilibrium model by Canto, Joines and Laffer. Blinder calibrates those formulas with empirically possible values of parameters. Only for the $\varepsilon$ - general price elasticity of supply of factors to the market sector is not empirical evidence available and thus the author tries values of 0, 1 and 2. If the value of $\varepsilon$ is 2, the revenue-maximizing tax on labor income according to Blinder's calibrations ranges from 0,26 to 0,3 and revenue-maximizing tax on capital income ranges from 0,42 to 0,57. For value of $\varepsilon$ being 1 or 0 the reported revenue-maximizing tax rates are significantly higher and since the author suggest that this elasticity should be rather low, he again concludes that the tax rates are only very unlikely in its prohibitive areas. [169]

Also **Fullerton** uses in his paper a general equilibrium static tax model in order to investigate the relationship of tax rates and government revenue.[170] The author focuses on the personal income labor tax and he runs over sixty simulations for different tax rates and different labor supply elasticities. For the basic value of labor supply elasticity (0,15) which he used, the tax revenue start to fall beyond the 78,8% tax of gross labor income.[171] That is substantially more than the actual total marginal wedge of 31,8% used in the model.

According to the simulation results the author suggests that the elasticity would have to be at least 2,5 to put the U.S. over the peak of the Laffer curve. Fullerton then presents estimates of labor supply elasticities which were done by other authors.[172] He then concludes that the reported rather low elasticities suggest that the tax cuts in labor income tax would not increase revenue according to his model and simulations. Thus he derives similar results as those reported by Blinder.[173]

## 4.1.B Country Specific Estimates

**Stuart** in his study[174] uses two-sector model, in one of them employed labor is taxed and in the second one, supplied labor is not taxed. The latter sector could be understood as

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[168] Ibid., p.87.
[169] See Blinder (1981), pp.89-91 for the calibration, the table of results for all values and for discussion.
[170] In Fullerton (1982), see pp. 8-12 for the basic describtion of the model.
[171] See Fullerton (1982), table 1 on p. 15 for detailed results of the simulations.
[172] See Fullerton (1982), table 2 on p. 18.
[173] However this "elasticities approach" as was used e.g. by Blinder (1981) and Fullerton (1982) has several shortcomings, see e.g. Canto et al. (1981), pp. 17-18 for description of those shortcomings of this approach.
[174] In Stuart (1981).

illegal tax evasion by undeclared activities as well as completely legal forms of tax avoidance (work in your house, watching children etc.). The derived model is used for parametrization on swedish data, where as a base year the year 1968 is employed and several scenarios are inspected.[175]

The author concludes that the then (in year 1977) highest marginal income tax rate (80%) is above the revenue-maximizing tax rate which would be roughly 70% according to his parametrization. He also states that severe effects (on growth of the economy) of tax increase above some critical value could be associated with adjustment lags to the change. Social institutions and laws as well as slow changes in attitudes toward labor market participation and tax evasion contribute to the sluggish reaction of individual labour supply on those tax changes.[176]

Very similar model and method of estimation is used by **Ravestein and Viljbrief**, who estimated Laffer curve for the Netherlands.[177] For the parametrization the year 1970 was selected as a basis year. The authors assumed that tax revenue are redistributed on a lump-sum basis and thus the revenue-maximizing marginal wedge tax rate equals 66,9% for year 1970 and 67,4% for year 1985. Therefore the Netherlands would operate slightly in the prohibitive area of the Laffer curve in year 1985, since in that year the marginal wedge reached its maximum. The authors also examined the welfare losses generated by tax increases.[178]

## 4.1.C Dynamic Models

Several studies explore the tax cut effects in models with endogenous growth. In such a setting the reduction in tax rate will have positive and permanent impacts on the growth rate of the economy, through the incentives created for savings and investment in either type of capital.[179] Thus the tax base might increase and the Laffer effects would express themselves in following years and the tax cut might eventually finance itself. Therefore the use of dynamic models seems appropriate.

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[175] See Stuart (1981), pp. 1022-1024 for detailed describtion of used model and pp. 1024-1029 for the parametrization.
[176] In Stuart (1981),pp. 1034-1035.
[177] See Ravestein & Vijlbrief (1988), pp. 206-209 for detailed describtion of the model.
[178] See Ravestein & Vijlbrief (1988), pp. 212-216 for the results of their parametrization and for sensitivity analysis.
[179] In Novales & Ruiz (2001).

This approach was probably introduced by **Ireland** in his paper.[180] He used simple endogenous growth AK production model[181] and he considers a single tax on output. The author finds that the dynamic Laffer effects are possible in the use of his model. On numerical example the author illustrates that although the permanent decrease in taxes would contribute to larger deficits, the expansionary effects could, *ceteris paribus*, in long-run generate larger revenue.[182] He concludes that the reduction in the marginat tax rate can be the key to both vigorous rates of real growth and long-run government budget balance in the U.S. economy today.[183]

Simple AK model was also used by **Agell and Persson**[184] and the authors use illustrative calculations for OECD countries to highlight the scope of dynamic Laffer effects in the real world. The authors introduce two different definitions of Laffer effects. The first is to study the revenue implications under the assumption that government sticks to its original consumption and transfer program, in spite of the fact that tax cut boosts the growth rate of output. The second is to assume that government is commited to to maintain constant spending ratios to output also after tax cut.[185]

The authors then conclude that there never can be Laffer effects in the sence of second definition in such a model.[186] They try to estimate the Laffer effects for the first definition. They have disregarded the probems concerning different taxation in the real world (physical capital is taxed by corporate and personal income tax, human capital is taxed by personal income tax and payroll taxes etc.) and set the tax rate in their model equal to the total tax revenue (including and excluding social security contributions) to GDP.[187]

The results are very sensitive to the intertemporal rate of substitution, if this rate is close to zero, then Laffer effects are not self-financing in any OECD country and some other tax have to be raised in order to compensate for the dynamic revenue lost. On the other hand, if intertemporal rate of substitution would be around 0,9 then nordic countries as well as

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[180] In Ireland (1994).

[181] The model could be described by following production function: $Y = f(K) = AK$, where K can represent human and physical capital and A is an exogenous technological constant, for the detailed description of the model see Ireland (1994), pp.560-562.

[182] See Ireland (1994), pp.568-570 for the numerical example.

[183] In Ireland (1994), p. 570.

[184] In Agell & Persoon (2000).

[185] Ibid., p.7, the exact definitions of those two approaches are given in pp. 8-9.

[186] See Agell & Persoon (2000), pp.13-16 for exact derivation of this fact.

[187] See Agell & Persoon (2000), pp.17-18 for the discussion about usage of a tax rate in their model.

Netherlands, France, Belgium or Austria may enjoy the benefits of dynamic Laffer effect when cutting the tax rates.[188]

Another paper which examines the dynamic Laffer effects was written by **Novales and Ruiz**.[189] The authors used endogenous growth model with two sectors for physical and human capital and they explored the Laffer effects for capital taxation and labor income taxation. The tax cut which produces positive effects on tax base and may allow for the repaying the debt which was initially issued by the government by the tax cut, the authors name feasible tax cut.[190]

The authors calibrate their model on US data and they start with initial values of capital and labor income taxation being 50% and 30% respectively.[191] They showed that feasible tax cuts can be quite substantial and the effects on long-run growth and welfare are increasing in the size of the tax cut. Largest feasible reduction in labor income taxation is to 15%, which leads to a welfare gain by 14,9% every period. The maximum feasible cut in capital taxation is to only 7% (while maintaining the income taxation on the level of 30%) and that leads to rather lower welfare gain of 12,6% every period.[192]

Evidently these derived results would change significantly if the values of parametrs of their model would change. For example the elasticity of substitution have to be above 0,56 in order to receive feasible tax cuts.[193] The authors also suggest that simultaneous smaller cuts in both tax rates could be preffered in terms of welfare gains. However, that is left for further research.

## 4.1.D Estimation of Laffer Effects without Deriving the Laffer Curve

A somewhat different approach was used by **Krause** in his recent study.[194] He uses general equilibrium tax model and tax reform techniques to directly examine the Laffer argument by characterising the conditions under which a small increase in labor income tax necessarily results in lower tax revenue.[195] This approach allows the author to directly

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[188] In Agell & Persoon (2000), pp 18-20.
[189] In Novales & Ruiz (2001).
[190] Ibid, p. 182.
[191] They also use the starting labor taxation being equal to 23%, to get the results of that calibration see Novales & Ruiz (2001), pp. 198-200.
[192] To see these results and their derivation see Novales & Ruiz (2001), pp. 191-200.
[193] In Novales & Ruiz (2001), p.205, however Agell & Persoon (2000) states that for US economy the coefficient must be at least 1,15 to enjoy feasible tax cuts. Thus you can see that different models might bring us very different results.
[194] In Krause (2007).
[195] The model is described in Krause (2007), pp. 6-8 and is based on classis general equilibrium tax model suggested by Diamond & Mirrlees (1971).

examine Laffer effects without deriving the Laffer curve *per se*. In this general setting the author concludes that the Laffer effects requires an economy with rather high labor income tax rates and labor supply considerably sensitive to changes in wages. Thus the labor supply elasticity have to be high in order to obtain the Laffer effects.[196]

## *4.2  Other Types of Estimations*

In this section we would review the estimates of Laffer effects which focuses on the tax evasion, when the tax rate is high. That kind of estimation was even esecuted for one type of indirect taxation –VAT. Also we review some economic experiments which tried to estimate the Laffer effects and confirm the existence of Laffer curve.

### 4.2.A Estimates based on Tax Evasion

In the study of Dutch authors **Heijman and van Ophem**[197] they try to take into account a possible shift to black labor activities (unreported or informal sector).[198]  Therefore their potential income consists of registred income (measured through GDP), non-realised income (inactivity of part of population) and non-registred income (black labor activities).[199] By means of discrepancy method the authors then estimates the size of the black labor economy and other variables for selected 12 OECD countries and they report the results for years 1995 and 1996.[200]

The revenue-maximizing tax rate ranges from 53% to 60%.[201] The authors then conclude that the revenue-maximizing tax rate is higher than the actual marginal tax rate in 11 of 12 examined countries.[202] Thus according to their model only in  Sweden  we can  witness overall Laffer effects, since the revenue-maximizing tax rate is 58% and the actual marginal tax rate equals to 65%.[203]

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[196] For the exact mathematic derivation of these conclusions see Krause (2007), pp.9-14.

[197] In Heijman & van Ophem (2005).

[198] See e.g. Schneider & Enste (2003) for the discussion about black labor activities, their reasons and impacts.

[199] See Heijman & van Ophem (2005), pp.716-718 for detailed description of their model.

[200] See Heijman & van Ophem (2005), pp.718-721 for description of the method used and for reported results. The authors had problems with the data to calculate the size of the black sector in every country, thus they fixed the size of black sector to 8,8% of registred income, which was the result obtained for the Netherlands. The authors suggest that this assumption proved to have little influence in the sensitivity analysis – see Heijman & van Ophem (2005), p.722.

[201] The tax rate used includes all taxes not only the income tax.

[202] In Japan and UK the revenue-maximizing tax rate is even twice that high as the actual marginal rate. The results are reported in Heijman & van Ophem (2005), p.719, Table 2.

The tax evasion and avoidance and the implications for Laffer curve are also examined in study by **Matthews**, who focuses on indirect taxation in particular on VAT in selected EU countries.[204] The author suggests that the design of VAT produce less incentives to evade, since the tax is paid and reclaimed at each stage of the production. However, on the other hand since there exist several rates of VAT in EU and other exceptions and derogations,[205] there is a possibility to avoid the higher rate by misclassification of the produced good.[206]

The author then develops a simple model and examines it on unbalanced panel data for 14 countries of EU. He uses the standard rate of VAT as a proxy for weighted average rate, since there is lack of the data. The author employs method of robust estimation and instrumental variable estimation for his model.[207] Matthews concludes that the quadratic term in the VAT rate is significant and correctly signed and thus it implies an existence of Laffer curve for VAT. The revenue-maximizing rate of VAT should be in the range of 18-19,3% according to his estimations and thus he argues that there could be the upper bound in EU for standard rate not higher than 19%.[208]

## 4.2.B Economic Experiments

The intresting way how to estimate the Laffer curve is by establishing an economic experiment. They allow the researchers to investigate the issue uder controlled conditions. There were not many experiments made, however we found two papers that examined the issue of Laffer effects in economic experiment.

**Swenson** in his study[209] reported an experiment where he examines the implications of Laffer curve on the labor supply, thus he again concentrated on personal income tax issue. Subjects in that experiment had to perform work by putting key strokes on a computer in order to receive some income per stroke. And alternative to working and receiving income subjects were able to read magazine, play video game on PC etc.

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[203] However, we think that the method of using a single tax which would aggregate all taxes in the economy could caused such results. We believe that it is rather more convenient to examine single tax in order to explore whether Laffer effects are present and the tax rate is in its prohibitive area or not.

[204] In Matthews (2003).

[205] See European Commission (2008) for detailed description of different VAT rates and exceptions for particular member states of EU.

[206] See Matthews (2003), pp. 106-108 for detailed discussion.

[207] See Matthews (2003), pp. 107-108 for the description of the model and pp. 109-112 for the data selection and the description of estimation methods used. The results are presented in Table 1 on p. 111.

[208] In Matthews (2003), pp. 112-113, note that the minimum rate for standard VAT in the then EC was set by the directive (92/77/EEC) at 15% and upper bound for the standard rate was assigned to be 25% by the political decision.

[209] In Swenson (1988).

Five different tax rates (12%, 28%, 50%, 73%, 87%) were given endogenously in random order. They applied for three consecutive periods of five minutes work. Swenson's conclusions do confirm the Laffer effects, the overall tax payments were maximized at second highest rate (73%) and the work effort was maximized at the second lowest rate (28%).[210]

Another real effort economic experiment concerning this topic was performed by **Sutter and Weck-Hannemann**.[211] The authors try to endogenize the tax rates by designing an interactive two-person game. One subject had to work to generate income and the second subject could taxed the generated income.[212] Apart the Laffer effects the authors also examined the effect of "veil of ignorance"[213] on the individual decisions by introducing two treatment conditions.

Under certainty treatment the individual positions are exogenously fixed and known from the beginning, however under uncertainty treatment both subjects are uncertain about their position (veil of ignorance) and thus both vote on the possible tax bound. The authors conclude that the tax revenue have their global peak at tax rates of 50-65%, thus confirming the Laffer effects, on the other hand authors also suggest that there could be more peaks in Laffer curve as we have already discussed. The effort levels decrease with a rise in tax rates as was expected, sharp decline in effort is around 50% to 55% tax rates.

Another finding was that there is no statistically significant difference in upper tax limits for the different treatment conditions. Therefore that does not confirm the hypothesis of more fair voting under veil of ignorance.[214]

## 4.3  Solely Econometric Estimations of Laffer Effects

In previous sections of this chapter we also reviewed some studies which used econometric estimations as well.[215] However, now we would focus on studies, where the econometric estimation was essential. Eventually we also will be able to examine the corporate income tax estimates of Laffer effects.

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[210] See Swenson (1988) for detailed results and discussion.
[211] In Sutter & Weck-Hannemann (2002).
[212] See Sutter & Weck-Hannemann (2002), pp. 4-6 and Appendix for the complete describtion of design of their experiment.
[213] This concept was introduced by Rawls (1971), where the decision makers know the possible states of society, however they do not know their specific position under those states of society.
[214] The complete results of the experiment are presented in Sutter & Weck-Hannemann (2002), pp.11-21.
[215] E.g. Matthews (2003).

## 4.3.A Personal Income Tax Estimation

The personal income tax was further estimated by **Yu Hsing**.[216] He examines the U.S. data for 1959-1991 and he uses four functional forms (linear, log-log, linear-log and log-linear) of a simple model similar to our benchmark model in next chapters.[217] The author chooses proportion of income tax revenue to taxable income as a representation of tax rate used and real income tax revenue per capita as the dependent variable. According to his results the revenue-maximizing tax rate for the U.S. personal income tax varies from 32,6% to 35,2%. Thus the author confirms the existence of Laffer curve and since average federal tax rates were lower (around 20%), the author suggest that there was a room for increase which would have been associated by revenue increase. However, the then marginal maximum of federal income tax at 36% was expected to be in the prohibitive area.[218]

## 4.3.B Corporate Income Tax Estimations

The Laffer effects for corporate income taxation were estimated in two recent studies. Both used the data for sample of OECD countries and the top marginal statutory corporate income tax rates. Kimberley **Clausing** was in her paper[219] examining the determinants of corporate tax revenue. For her model she examined the data for years 1979 to 2002 for 29 OECD countries, however some countries were added only for several years in the analysis (transition economies, Korea and others were added in the mid 1990's). With the simple model similar to one we present in following chapters she confirmed the shape of the Laffer curve, although she does not mention it directly. Moreover the revenue-maximizing tax rate according to her results would be around 33%.[220] Then she also added some other variables into the model, which improved the fit of the model[221] and if we calculate the revenue-maximizing tax rate it increased to the range of 39 to 41,5%.

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[216] In Yu Hsing (1996).

[217] See Yu Hsing (1996), pp. 397-398 for description of the model and functional forms. We believe that the use of different functional forms is not fundamental, since the results are very similar and thus in our model we use solely the linear specification.

[218] See Yu Hsing (1996), pp. 398-400 for the reported results and following discussion.

[219] In Clausing (2007).

[220] See Clausing (2007), pp. 126-127 for detailed results.

[221] Such as the corporate share in the GDP and corporate profitability, however the number of observations is reduced significantly by that. In our models we do not present such variables. Our time period starts from year 1965 and if we add those variables, the number of observations would reduce by at least two thirds, since there is significant lack of those data. Therefore we stick to our benchmark model and then we try to find the best appropriate econometric representation. However, the results which we present closely resembles to those reported by Clausing.

**Brill and Hassett** use the similar model of 29 OECD countries for years 1980 to 2006. They examine the data on the simple benchmark model and they conclude that the revenue-maximizing corporate tax rate is in the range of 30 to 37% depending on the countries included in the sample.[222] Moreover they test whether the Laffer curve was constatnt for the whole time period. They find out that the results for 5 (6) years period do not differ significantly. However, in the latest six year period (2000-2006) the revenue-maximizing tax rate decreased under 30%.[223]

## *4.4 Concluding Remarks*

We have seen that there are several ways how to estimate the Laffer curve and (or) the Laffer effects. As we have witnessed the concept of Laffer curve is not disputed *per se*. However, the literature is diverging in the conclusions, some authors do confirm that the Laffer effects could occur for some tax rates in some countries and thus they would operate on the prohibitive range of the Laffer curve. On the other hand, some authors claim that it is highly improbable that those effects could be discovered for some broadly based tax.

Since the issue of Laffer curve and Laffer effects for corporate income taxation was not reviewed many times, we would focus on this taxation. Moreover, we think that firms and corporations have several possibilities how to avoid high profit (income) taxation and thus support the Laffer effects. Thus before we introduce our econometric models, we will focus on the effects on corporate income tax revenue and how the corporations are able to avoid high taxation in the next chapter.

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[222] See Brill & Hassett (2007), tables on p. 15 for the results of regressions and pp. 9-10 for comments regarding the results.
[223] See Brill & Hassett (2007), tables on p. 16 and pp.11-12 for comments.

# 5 Corporate Tax Rates, Revenue and Possible Laffer Effects

In this chapter we would focus on the corporate income taxation. We examine the trends in tax rates and corresponding tax revenue from this taxation in OECD countries. We also slightly review the issue of tax competition. Then we focus on the determinants of tax revenue and the possibilities how the Laffer effects could arise in the corporate income taxation.

## 5.1 Development of Corporate Income Tax Rates

We would explore the development in the corporate income taxation on 20 OECD countries, although there is currently 30 OECD member countries.[224] This group of 20 OECD countries is also explored in our panel data model in chapter seven. Reasons for that reduction are mainly the unavailability of the data for remaining 10 countries. These reasons and also the list of examined countries are listed in section 7.1 of this thesis.

In Figure 5.1 you can find the development of statutory corporate income tax rates in our sample of 20 OECD countries since 1965 until 2006. Those statutory rates are either top marginal rate (if in a given country there is a progressive taxation system) or a standard statutory rate. From the figure we can see that until the year 1985 the average statutory corporation tax rate slightly increased and they reached its peak of 44,9% in year 1985. Since then we can see visible decreasing trend.

The average statutory rate was at its minimum of 29,1% at year 2006. The mean value of average statutory corporation tax rate is 38,9%. Therefore there are signs of corporate tax competition which push the tax rates down, however the "race to the bottom" is not that rapid and we would discuss this issue and also other possible explanations of this trend in corporate tax rates in greater detail below.

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[224] For the complete list of OECD countries see e.g.:
http://www.oecd.org/countrieslist/0,3351,en_33873108_33844430_1_1_1_1_1,00.html

**Figure 5.1: Development of Average Statutory Corporation Income Tax Rate in 20 OECD Countries from 1965 to 2006[225]**



Source: World Tax Database (University of Michigan), OECD, see section 6.1.D for detailed description of used data sources

In Figure 5.2 you can moreover see the development of statutory corporate income tax rates in all our sample countries. We state there the rates in the beggining of the period (1965) in the middle (1985) and on the end of the period (2006) as well as the average tax rate for each country.

From Figure 5.2 it is evident that in most of the countries the statutory tax rates felt significantly. The most notable decrease was in Ireland, significant decrease of corporate income tax rates was also in Sweden, Luxemburg or Finland. On the other hand, the statutory corporate tax rates even slightly increased in Spain and almost did not change in Italy. However, those are the only two exceptions.

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[225] Note that we are using unweighted averages of statutory tax rates.

**Figure 5.2:Corporate Income Tax Rates for Selected Years (in % )[226]**
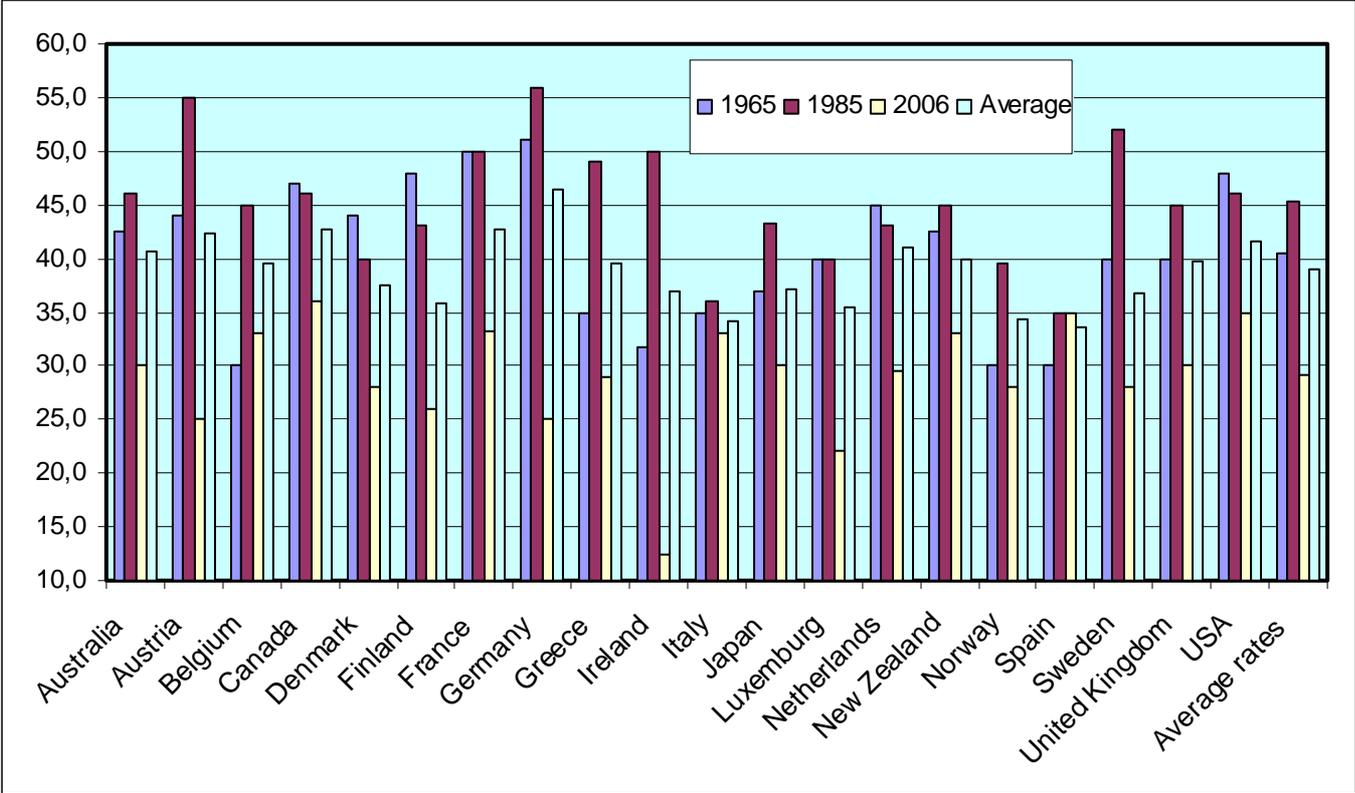


Source: World Tax Database (University of Michigan), OECD, see section 6.1.D for detailed description of used data sources

## 5.1.A Tax Competition as an Explanation

We would now discuss the possible explanations of the declining trend of corporate income tax rates since the late 1980's. The main candidate to explain this trend is the corporate tax competition, where the countries or regions compete to attract firms and capital to settle down in their country. The tools for the competition are evidently the statutory corporate tax rates as well as overall corporate environment (regulations, penalties, legal tax base, existence of tax holidays, existence and size of other taxes etc.) Therefore we would review fundamentals of this concept.

The opinions of authors differs greatly in this topic, some of the papers support the idea of tax competition and its benefits for the welfare, on the other hand, others support the idea of tax harmonisation (convergence of tax rates and unification of tax rules and tax bases). In 1950's Tiebout tackled this issue in his theory of local public good provision.[227] In his

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[226] Since we do not have data for United Kingdom for year 1965, we substituted this tax rate by corporate tax rate in 1970 – which is the first available.
[227] In Tiebout (1956).

setting low taxes as a result of tax competition stimulate individuals to reside in that region with these low taxes and a certain level of public goods being provided. This approach could be extended, *inter alia,* to include mobile firms in the model. They are modeled in a similar manner as mobile residents, only the assumtion of infinitely elastic supply has to be fulfilled.[228]

The tax competition which is harming and wasteful is ussually described by some departure from the idealized setting as it is described by Tiebout.[229] Those departures could be understood as different kinds of externalities such as interregional, pecuniary or fiscal externality.[230]

Some authors fear that in the most pesimistic scenarios the tax competition will lead to a "race-to-the-bottom" and it will end up with very low taxes and therefore the public goods will be underprovided.[231] Therefore there are tendencies to introduce at least minimum tax rates and furthermore harmonize different tax systems among OECD or EU countries.[232]

The literature is not unified even in evaluating whether the decline in corporate tax rates is a result of tax competition. For example Slemrod in his paper[233] examined the data for selected OECD countries on time period 1975 to 1995. He concludes that according to his analysis there is not much direct evidence that competitive pressures have large effect on statutory corporate tax rates and the author would suggest that it is rather the **convergence of countries in economic structures** that caused this trend.[234]

Steward and Webb examined the corporate tax burdens in OECD countries between 1950 and 1999. They concluded that there is no evidence of the race-to-the-bottom and only very limited evidence of harmonization of tax burden[235].

On the other hand, for example Devereux et al. in their paper examined the data for 21 industrialized countries from 1983 to 1999.[236] They tried to estimate the tax reaction functions for the national governments based on detailed measures of corporate taxes. The author finds evidence that countries do compete over statutory corporate tax rates (and

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[228] See e.g. Richter & Wellisch (1996) for this kind of extension of the model.
[229] See Tiebout (1956).
[230] For the description of those externalities see Wilson (1999), pp. 272-273.
[231] See Grifith & Klemm (2004), p.3.
[232] See e.g. Nicodeme (2006), pp. 33-36 for explanation of gains from the corporate tax coordination. On the other hand, Parry (2003) tried to calculate the welfare losses in case of capital tax competition, he states that they seem to be very small and thus they do not support the idea of setting the minimum tax rates in a bloc of regions or countries.
[233] In Slemrod (2004).
[234] See Slemrod (2004), pp. 1183-1184.
[235] In Steward & Webb (2006), pp. 189-191.
[236] In Devereux et al. (2002).

effective average tax rates) and that competition is assymetric. Thus countries react more significantly to changes when their tax rate is above average.[237]

## 5.1.B Different Explanation

Other hypothesis for the trend in the late 1980's and beggining of 1990's was stated by Gordon.[238] The author noticed that the statutory corporate tax rates on a central government level felt significantly in US in 1986 to 1988 (drop from 46% to 34%). He suggested that U.S. economy have inordinate influence on other economies and therefore other countries followed this trend.[239] However, since then the statutory corporate tax rate in U.S. did not change (see Figure 5.2) but the trend in other countries countinued. Thus there have to be some other reason for that trend (tax competition, convergence in economic structures etc.)

In this section we have tried to explain the declining trend in the statutory corporate tax rates in last 30 years. One most profound explanation is the corporate tax competiton. However, some studies do not confirm that influence or the evidence is weak. We would conclude that there are probably several reasons for that  decresing trend such as tax competition, convergence of economic principles etc.


# *5.2  Development of Corporate Tax Revenue*


If we focus on the state revenue from the corporate income taxation in our sample of 20 OECD countries, we see that this rather fundamental decrease of tax rates since mid-1980's was not accompanied by similar decrease in tax revenue. Moreover, as could be seen from Figure 5.3  the tax revenue from corporate income taxation rose in 1990's. At the year 1965 thus on average the corporate tax revenue generated 2,1% of GDP and in the last year of our investigation (2006) this revenue on average reached 3,9% of GDP. The mean value of corporate tax revenue reaches 2,63% of GDP.  From the  presented figures we can see that the tax revenue did not copy the trend in tax rates. That could have several reasons and explanations and we would focus on them in the final section of this chapter. We hypothesize that Laffer effects could have played a major role in that trend.

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[237] See Devereux et al. (2002), pp. 26-31 for the discussion concerning the results and Table 2 on p. 41 for their detailed results.
[238] In Gordon (1992).
[239] See Gordon (1992), pp. 1177-1178.

**Figure 5.3: Development of Average Corporate Income Tax Revenue to GDP ( in %) in 20 OECD Countries from 1965 to 2006**[240]
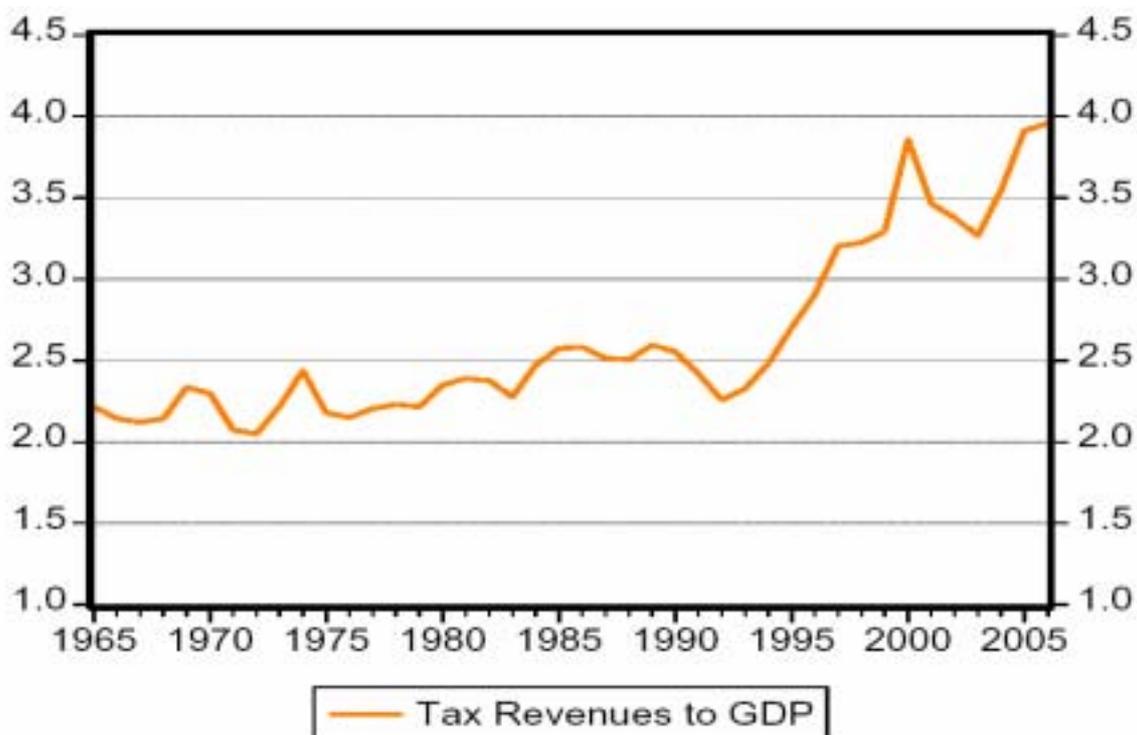


Source: OECD statistics, International Financial Statistics (IMF), own computations, see Section 6.1.D for detailed description of used data sources

There are also considerable country differences, while the least average corporate income tax revenue for the time period of 1965-2006 were in Greece – solely 1,4% of GDP, the country with highest level od those average tax revenue is Norway with 4,3% of GDP. You can see those country specific developments in Figure 5.4, where we include all 20 countries and corporate income tax revenue again for three selected years (1965, 1985 and 2005) The last column for each country is the average tax revenue during the whole time period (1965-2006).

We can highlight the develoment in Norway, where in 1965 the corporate tax revenue was slightly above 1% of GDP and after 40 years they exceeded 11,5% of GDP.[241] We can conclude that in most of the countries from our sample the ratio of tax revenue to GDP has increased (mainly during the 1990's), in some countries such as in Norway or Greece, that increase was substantial. On the other hand, in Canada, Germany and in the

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[240] Note that we are using unweighted averages of those tax revenue.
[241] This is mostly explained by the high oil revenue in Norway, see e.g. Brill & Hassett (2007), p.10 or OECD (2007), p.30.

United States the tax revenue to GDP slightly decreased from 1965 to 2005 as could be seen from the Figure 5.4.

**Figure 5.4:Corporate Income Tax Revenue for Selected Years (as % of GDP)[242]**
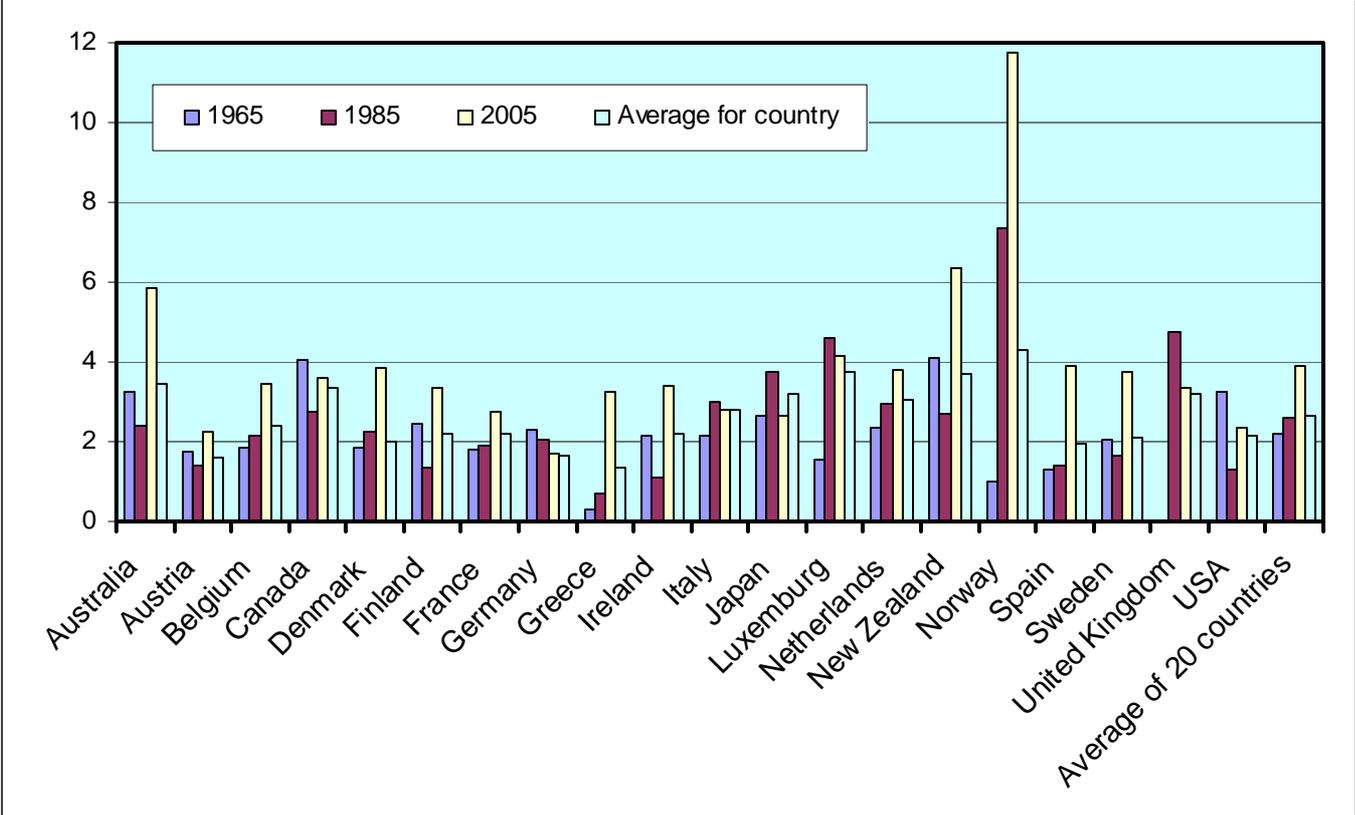


Source: OECD statistics, International Financial Statistics (IMF), own computations, see section 6.1.D for detailed description of used data sources

## 5.3  The Determinants of Corporate Tax Revenue

Evidently there are more factors which influence the corporate income tax revenue. The simplified formula could be written as $\mathrm{Re}\,v = statutory\ tax\ rate * tax\ base$. The corporate tax base is influenced by several direct and indirect factors and we would shortly examine them.

As we have already seen in the previous chapter according to the theory the revenue would not react the same on e.g. one percentage point increase of corporate income tax rate. The arithmetic effect of such a change states that if the change does not influence the tax base, the revenue would increase proportionaly. However, the economic effect of such a change

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[242] Note that we do not present the corporate income tax revenue to GDP in United Kingdom in year 1965, since we do not have the data available.

would influence the tax base and thus the revenue could increase more (less) than proportionaly or certainly even decrease if we are in the prohibitive area of the Laffer curve. Thus it is fundamental to review the factors influencing the corporate income tax base.

## 5.3.A Direct Effect Influencing the Tax Base

As a direct effect we would mention the **legal tax base**, which is set of rules and principles introduced by the particular government. It basicly tells which profits could be deducted and which have to be included into the tax base of a corporation. It is very complex and vast legislation covering allowances for capital expenditure, valuation of assets, extent which expenses could be deducted from tax base, deductibility of contributions to pension reserves etc.

The OECD study tried to examine the legal tax base, however they were able to evaluate solely the depreciation allowances.[243] According to this analysis, they concluded that less generous tax depreciation allowances and elimination of special tax deductions and provisions have broaden the tax base in OECD countries, especially during the second half of the 1980's.[244] Thus this could be one explanation of the growth of the corporate tax revenue.

## 5.3.B Indirect Effects Influencing the Tax Base

There exist several other factors influencing the tax base variable indirectly. For our purposes we would divide them on **factors of Laffer effects** and **other (non-Laffer) factors**. The former would suggest that the lower corporate tax rate in a country, *ceteris paribus*, would positively influence the tax base and thus it would positively stimulate the tax revenue. Obviously this would be valid, *vice versa,* as well. The latter, on the other hand, would imply that due to this factors the tax base increased, *per se* (there is no influence of corporate tax rates). We would now examine both these groups little closer.

## 5.3.C Factors of Laffer Effects

We can start the specification of those factors with **location decisions of multinational firms**. Multinational firm takes into account the corporate tax rate as well as other factors (corporate environment etc.) to decide where to locate its production or affiliate. Thus this would suggest that countries with lower corporate tax rates and with more suitable

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[243] See OECD (2007), pp. 24-26.
[244] In OECD (2007), p. 33, note that the analysis is incomplete since the comlexity of the legal tax base.

corporate environment will attract those firms to reside and produce in their area.[245] Devereux et al. concluded that the countries compete over statutory tax rates and thus the choice of multinational is ussually discrete between two locations as they stated in their model for mobile firms.[246] Therefore the tax base in the countries with lower tax rates and more favourable corporate environment should increase according to this effect.

## Profit Shifting

Another possibility how to avoid high corporate tax rates for the multinational corporation in the globalized economy is the possibility of profit shifting. There are several ways how this could be done, we would mention transfer pricing, re-assigning of common expenses and use of financial structure of company.

The **transfer pricing** refers to the pricing of contributions transferred within an organization. Specifically, the multinational firm can reduce accounting profits in a high-tax country by overstating the prices of imports into this country and conversely by understating the prices of exports.[247]

Most countries enforce such tax laws which are based on the arm's length principle as defined in the OECD Model Tax Convention.[248] Thus the transfer pricing is not legal in most of the countries. This principle basically states that prices should be the same as if the parties in the transaction would have not been related to each other.[249] This should obviously limit the transfer pricing and it should ensure that the country gets to tax its proper share.

However even if those measures exist there is evidence on the transfer pricing. It is For example Bartelsman and Beetsma found out that on the data for sectoral data for 16 OECD countries and for time periods of 1970 to 1997 that this transfer pricing could be significant. They used back-of–the-envelope calculations and they suggest that a one-percentage point increase in the corporate tax rate leads to a 2,7% reduction in corporate tax revenue compared to the case when profit-shifting is absent.[250]

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[245] See e.g. Hines (1996), pp. 39-40 for further discussion.
[246] See Devereux et al. (2002), p. 31 for conclusions and pp. 9-13 for the description of model with mobile firms.
[247] In Huizinga & Laeven (2005), p. 2.
[248] See OECD (2003), article 9 on p. 12.
[249] In Bartelsman & Beetsma (2000), p.3.
[250] See Bartelsman & Beetsma (2000), pp.8-10 and Table 2 for reported results. The authors also tried to regress the tax revenue on tax rates and that produced an insignificant coefficient. We have to state, that they did not use the quadratic term of tax rates (to record for the Laffer effects) in that regression and that was probably the reason of such a result of insignificant coefficient.

On the other hand, Swenson examined the reported transfer prices for set of products imported into the U.S from several countries between 1981 and 1988. She found only small effect of import prices on the tax revenue.[251]

The multinational firms can furthermore affect the allocation of accounting profits through **assigning debt to the high tax rate location**.[252] Thus the firm would reduce its tax base and in that location and increase the tax base in the other location with lower tax rate.

Another possibility of profit shifting for multinational company is the **re-assigning of common expenses** (R&D expenses etc.) to high tax locations.[253] Thus the accounting profits in those locations would be obviously decreased and could be increased in low tax countries. Those profit shifting efforts should lower the tax base in high tax countries and contrariwise increase it in low corporate tax countries.[254]

Since we examined those two factors (Laffer effects) influencing the tax base, we have to mention the role of **tax havens**. Those are countries with no or very low tax rates. Tax havens use means to help companies camouflage their home country tax avoidance.[255] Typical example could be Malta, San Marino, Bahamas or Jersey.

Other countries therefore use resources and certain provisions in an attempt to limit the transfer of tax revenue to the tax havens. Although this would suggest that the abolition of tax havens would stimulate the tax revenue and improved welfare in other countries the literature does not give such clear evidence.[256]

**Further Laffer Effects**

Yet another factor could be labeled as Laffer effect. The lower corporate income tax rates could increase the incentive to incorporate, if on the other hand the personal income tax rates are much higher. Therefore the profits could be shifted from non-corporate sector to corporate sector and thus it would positively influence the tax base.[257]

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[251] See Swenson (2001), p.22.
[252] In Huizinga-Laeven (2005), pp.2-3.
[253] Ibid., p. 3.
[254] See e.g. Huizinga-Laeven (2005) for the empirical evidence of those forms of profit shifting in Europe. They concluded that most of the European countries may have gained some tax revenue at the expense of Germany.
[255] In Slemrod & Wilson (2006), p. 3.
[256] For example Slemrod & Wilson (2006) conclude that elimination of tax havens would improve the welfare in non-haven countries. On the other hand, Hines (2004) claims that the solution is unclear, since the tax haven activity stimulate investments in nearby high-tax countries.
[257] For the evidence see e.g. Gordon (1998), who discovered that effects for U.S. economy mainly in 1950's and 1960's.

As the last example of Laffer effects influencing the tax base we can mention the **inflow of investments**. The reduced tax rates may increase the total amount of investment and thus it could positively influence the corporate profits and the tax base.[258]

## 5.3.D Non-Laffer Factors

We regard mainly two other factors which would influence the corporate tax base in a given country independent of the tax rate. The decline of certain sectors such as agriculture stimulate the importance of corporate sector.[259] Therefore that changing structure of economy could have also stimulated the tax base.

Finally we can mention **stricter enforcement of corporate tax laws** and provisions. Intensified tax audits and greater sanctions might reduce the tax avoidance and tax evasion behaviour and thus strengten the tax base *per se*.[260]

In this chapter we have reviewed the development of corporate income tax rates and revenue in sample of 20 OECD countries. Moreover we have tried to explain those developments and trends. The tax revenue are influenced by several factors. Apart from the arithmetic effect of tax rate, the corporate tax rate influence the revenue indirectly through tax base. Those factors we called Laffer effects. In the next two chapters we would try to capture those Laffer effects and estimate the Laffer curve for selected countries and for a panel of countries.

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[258] See e.g. Bénassy-Quéré et al. (2005) for panel study of 11 OECD countries from 1984 to 2000, where they conclude that tax differences do play crutial role in FDI locations.
[259] In OECD (2007), pp. 33-34.
[260] Ibid, p. 34.

# 6     Time–Series Models for Three Selected Countries[261]

In this chapter we will investigate and estimate the Laffer curve on the corporate icome tax for three selected countries using time-series model. Next chapter will then create a panel of selected OECD countries and estimate the Laffer curve on the panel data. However, the author believe that it is important to examine the time-series data for at least some selected individual countries as well, in order to cover for the differences of particular countries which would arise.

It is straightforward that the model with panel data would inevietably delete those differences (although we would allow for the country specific effects), since it will aggregate the data for the whole selected group of countries. Moreover, in the previous chapter we have seen that the development in tax rates and tax revenue was country-specific. Therefore, in this chapter the time-series model for Ireland, France and United Kingdom is chosen in order to show different outcomes for those countries. We selected those countries mainly because of illustrating these differences. Other reasons why these three particular countries were selected are stated in each country-specific section.

First in this chapter the model, *per se,* would be explained. Then the structure of the model, data range and their sources, the used variables and their significance would be described. Also we would mention some limitations of the used model. In the next parts the individual countries would be explored and we would present the outcomes of the model. Also the assumtions of the time-series and classical regressions would be discussed in each case.

## *6.1 Benchmark Model*

The basic and benchmark model for our purposes is presented in the equation (2). The model presented is still linear (the parameters of the model are linear), although the tax variable is non-linear in the latter case.

$$\frac{REV_t}{GDP_t} = \alpha * TAX_t + \beta * TAX_t^2 + \varepsilon_t \qquad (2)$$

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[261] All the estimations in this and consequitive chapter were done using the EViews 5.0 econometric software.

The theory of Laffer curve suggests that the origin of the Laffer curve should initiate in the point $[0;0]$ and therefore we do not include intercept into our benchmark model. It is evidently derived from the fact that with zero tax rate there are no tax revenue from and thus the origin is at point $[0;0]$.

## 6.1.A Description of Variables

Let us now describe the variables which would be used in our model.

$REV_t$ - state revenue from the corporate income tax at a given year t (in nominal terms)

$GDP_t$ - GDP at year t (in nominal terms)

$TAX_t$ - statutory corporate income tax rate on the central-government level at year t

$TAX_t^2$ - statutory corporate income tax rate sqared at year t

$\varepsilon_t$ - error term

## 6.1.B The Structure of the Model

In this section we would discuss the structure of the model and the inclusion of above mentioned variables into the model. The explained (dependent) variable is in our case $\dfrac{REV_t}{GDP_t}$ - the proportion of corporate tax revenue to GDP was selected for several reasons.

The GDP term itself should be in the equation in order to capture for the influence of rising (declining) GDP on the revenue. Evidently the revenue should, *ceteris paribus*, rise with rising GDP and, *vice versa,* in most of the times. On the other hand, if the GDP term would be incorporated on the right-hand side of the equation (2) there would be a forceful threat of the spurious regression relation.[262] The GDP term would itself capture the volatility of revenue and thus the tax variables could not be signifficant. Therefore we include the ratio of corporate tax revenue to GDP as explained variable.

The ratio of those variables is important for our purposes and therefore the data for those two variables could be in their nominal levels (in current prices) in national currencies. Since the ratio would be the same for nominal values as well as for the values transferred on

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[262] Again see Yule (1926) for the first reference about the spurious regression and further e.g. Granger & Newbold (1974) for several Monte Carlo simulations on spurious regressions.

the same base year by deflator and (or) transferred to US Dollar or Euro currency, we do not need to perform such transformation.

The inclusion of explanatory tax variables $TAX_t$ and $TAX_t^2$ is rather straightforward and it should confirm the presence of Laffer curve phenomenon as would be explained below.

## 6.1.C Other Factors Influencing the Size of Revenue and Their Possible Inclusion into the Model

As we know from the previous chapter, the GDP term and the tax rate are not the only two variables which would influence the corporate tax revenue. Most important would be the **tax base** which could vary due to several reasons. The indirect Laffer effects such as variation due to the fact that there are, *ceteris paribus,* more (less) firms and corporations present in the corporate environment of the particular country, or the multinationals shift profits were closely described in previous chapter. These factors are to some extend implicitly projected into the GDP term.[263]

Moreover, the tax base is also directly influenced by the legislation decisions of particular country (legal tax base). Since it is not possible to present any variable which would capture at least most of these factors and since the availability of such data is also very limited, we do not present any variable on the variation of the tax base in the model.

Apart from those, also the corporate tax rates in other foreign countries could play an important role in the size of the collected revenue – due to profit shifting and location decision of multinational firms as was already reviewed.. Therefore, we try to include the **difference of tax rates variable** in our selected country and in the country with least tax rate in the particular year among the sample OECD countries. These differences should partially cover the possibilities of companies to relocate the residence or entirely transfer the production into country with favourable tax rates.[264] We thus expect the coefficient of this variable to be negative since the bigger the difference, the greater the probability of transfering the production.

For the sake of parsimony this variable is included into the model only in the case when it is significant. We also try to find the best specification of the model. Thus in each particular case the new model which is derived from our benchmark model is presented.

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[263] If we would use the approach as Clausing (2007) used to approximate those influences, we would lose significant number of observations (two thirds) as was already mentioned. Therefore we rather use this simple model and try to find the best econometric specification for it.

[264] This approach is not the best since it does not cover for the tax havens. Also it treats all the countries in our sample the same, however it should be stated that it is not the same for a company from United Kingdom to set up affiliate in for example Japan or Ireland.

## 6.1.D Data Range and Sources

To obtain the data was not a simple task, however it was possible to obtain the main data for most of the chosen countries for years 1965-2006. On the other hand, there are some observations missing (mainly for the corporate tax rates) and we would discuss it later in the text.

The tax revenue from corporate income tax for the central government level were collected from OECD statistics.[265] The GDP at current prices were also obtained from the OECD statistics, however the range of those data is for many countries only from year 1970. Thus to obtain those additional years the International Financial Statistics of International Monetary Fund (IMF)[266] was used.

The most problematic part were the corporate tax rates. Two main data sources were used to obtain the central-level statutory corporate tax rates. In some cases and some time periods countries used the progressive tax system for corporate income tax. Thus there were several tax rates, but we use only the top statutory tax rate in those cases.[267]

The tax rates were obtained from the OECD source[268], however the data range is limited only to period since year 1981 until 2006. Therefore the additional data were collected from the World Tax Database, which is a project of the Office of Tax Policy Research and the Center for International Business Education at the University of Michigan.[269]

If there is any additional source of the data for particular country used, it would be reported in the corresponding text.

## 6.1.E  The Existence of Laffer Curve and the Revenue-maximizing Tax Rate

The existence of the Laffer Curve would be confirmed if both the tax rates parameters ($\alpha, \beta$) are significant and if they have their expected signs. To obtain the bell-shape of the Laffer curve the $\alpha$ parameter should be positive and $\beta$ parameter should be negative.

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[265] This statistics is available at: http://stats.oecd.org/wbos/, we used  corporate taxes on profits (cathegory 1210 of the OECD classification of taxes). Last data were downloaded on the 15th March 2008.

266 This statistics is available at: http://www.imfstatistics.org/imf/.  I am grateful to Mgr. Tomáš Holub, Ph.D. from CNB for the possibility of usage of this source.

[267] See the section concerning limitations of the used model below, where the issue is explored in more details.

[268] The tax rates are available at:
http://www.oecd.org/document/60/0,3343,en_2649_34533_1942460_1_1_1_1,00.html

[269]  The database is available at: http://www.bus.umich.edu/otpr/otpr/introduction.htm. The data were downloaded on the 25th February. I am indebted to Professor Joel B. Slemrod and Professor James R. Hines Jr. from University of Michigan for informing me about this database.

The extreme value theorem in mathematics states that the continous function on a closed interval must attain its maximum and minimum value, each at least once.[270] We do have closed interval and our function is continous. If the Laffer curve would have the desired bell-shape, we know that the points which would minimize the ratio of revenue to GDP are on the border of the set – at points $[0;0]$ and $[TAX_{min};0]$, where the Laffer curve intersect the x-axis again.

Thus we know that the revenue-maximizing tax rate ($TAX_M$) point of the Laffer curve lies inside the set. To calculate that point we need to calculate first order conditions, which in this case correspond to the derivation of equation (2) with respect to TAX variable should be equal to zero.

Thus:

$$\frac{d\,\frac{REV}{GDP}}{d\,TAX} = \alpha + 2\beta\,TAX_M = 0$$

$$TAX_M = -\frac{\alpha}{2\beta} \tag{3}$$

Therefore if in our time-series and panel models the bell-shape of Laffer curve would be confirmed, we would use the Equation (3) to obtain the revenue-maximizing tax rate ($TAX_M$) and we would discuss its magnitude.

## 6.1.F The Issue of Stationarity

The weak stationarity (second-order stationarity) of time series data is defined that first two moments of probability distribution of such a serie are invariant over time. We could rewrite that: stochastic process is stationary if its mean and variance are constant over time and the value of covariance between the two periods depends only on the distance (or lag) between the two time periods.[271] The stationarity of time series is important in estimating those series. If the time series are non stationary, there are several problems of the estimation which arise.[272]

The ratio of revenue to GDP according to the theory should not incline to be non-stationary. However for the limited time period we are using, there may be some cases where

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[270] For the exact wording of this mathematical theorem and for its proof see e.g. Hájková et al. (2000), pp. 57-58.
[271] In Gujarati (2003), pp. 797-798.
[272] See e.g. Gujarati (2003) pp. 792-802.

the serie will be non-stationary. Thus we will present some tests of stationarity and comment them. If we discover that there the non-stationarity is present in our time serie, we however will not use the transformation of that particular serie using the first (or any other) differences. In that case we would lose the economic explanation of Laffer phenomenon behind the data. We would rather try to detrend the time serie by using some additional trend variable in our model in order to let the residuals be stationary in the situation, where it is possible.

## 6.1.G Limitations of the Chosen Model

There are several limitations of the above described model, which the author is aware of. These limitations should be outlined and discussed to a certain extend.

As was already mentioned we **use the linear model**, therefore the parametrs ($\alpha, \beta$) cannot vary. However, for our purposes the above specification should be sufficient. We are intrested in the validity of the Laffer curve and in the revenue-maximizing tax rate and thus the exact shape of the curve is not that important for us. Also the use of nonlinear regression models brings some other difficulties and therefore we would follow the linear model.[273]

Another limitation is the **non-inclusion of legislative tax base variable** into the explanatory variables of our model. As was explained above the inclusion is almost impossible due to the lack of data and complexity of the issue. Therefore the part of the data which would be unexplained by the model could be explained mainly by the development of this variable.

Finally we have to mention **the use of corporate tax rates data**. We were able to obtain the statutory tax rates, however in the case of progressive taxation the top statutory tax rate is used. That is due to the fact that it was not possible to calculate average tax rate, since there is lack of the data. For the time-series part of the estimation we use only countries where the tax rate has never been progressive for the whole time period and therefore this problem did not arise. However in the case of panel data in some countries this problem would arise. On the other hand, in the presence of progressive taxation, the top statutory tax rate is the rate which mostly influence the behaviour and decision-making of firms and corporations. Also there was only few countries executing the progressive taxation in certain time period in our sample. Therefore we would conclude that this problem is not crutial and we can still present and comment the obtained results. Moreover the recent studies of Clausing or Brill and

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[273] For the introduction to nonlinear regression see e.g. Gujarati (2003), pp. 563-567 or Maddala (2001) pp. 392-436.

Hassett,[274] which were presented in chapter four use the same approach concerning the corporate income tax rates.

In the next part we would present the results of time-series model for selected countries: Ireland, France and United Kingdom. First the results for benchamark model will be presented, then we would try to find the most appropriate representation for our model according to econometric rules and tests. In the last part of this section we would compare the results and draw some preliminary conclusions from these time-series models of selected countries.

## *6.2  Ireland*

Ireland was selected for various reasons and we will briefly discuss them. All the data for our benchmark model for Ireland are available for the whole period from 1965-2006. Only the sources mentioned in the previous section were used in obtaining the data for Ireland.

Moreover, the statutory company income tax rates have been uniform for the whole time period (no progressive system). Until 1975 the statutory rates were given in shillings and pence per pound and they were converted into percentage. Since 1975 the tax rate has been given in the percentage.

Third reason why Ireland was chosen for our model is the development of the corporate tax rate *per se*. During the 1970's and 1980's the tax rate reached its peak of 50% for several years. Since then there is a visible downward trend and from year 2003 the corporate tax rate is only 12,5%. That makes Ireland the country with second lowest central government corporate tax rate in OECD countries.[275] It is obvious that the development of the tax rate was rather considerable and that could be an advantage for our analysis.

In Figure 6.1 you can see the development of the corporate tax rates and tax revenue as percentage of GDP in Ireland over the selected period. The scale for the tax rate is on the left-hand side axis and the scale for tax revenue is on the right-hand side axis. From this figure there is evidently visible the downward trend of tax rates since 1990. However, this trend was not accompanied by the similar decrease of tax revenue. The opposite is true, the tax revenue steadily rised since 1989 and in the year 2006 they exceede 3,8% of GDP in

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[274] We refer to Clausing (2007) and  Brill & Hassett (2007).
[275] The lowest central government corporate tax rate is in Switzerland (8,5%), however if the sub-central corporate tax rates are included, the combined tax rate exceeds 20% in Switzerland. See http://www.oecd.org/document/60/0,3343,en_2649_34533_1942460_1_1_1_1,00.html table II.1 and II.3.

comparism to 1,1% of GDP in 1989. These developments could suggest that apart from other influences, the Laffer effect is present in the case of corporate taxation in Ireland. We would now focus on more detailed and exact analysis of this issue.

**Figure 6.1: Tax Rates and Tax Revenue in Ireland**
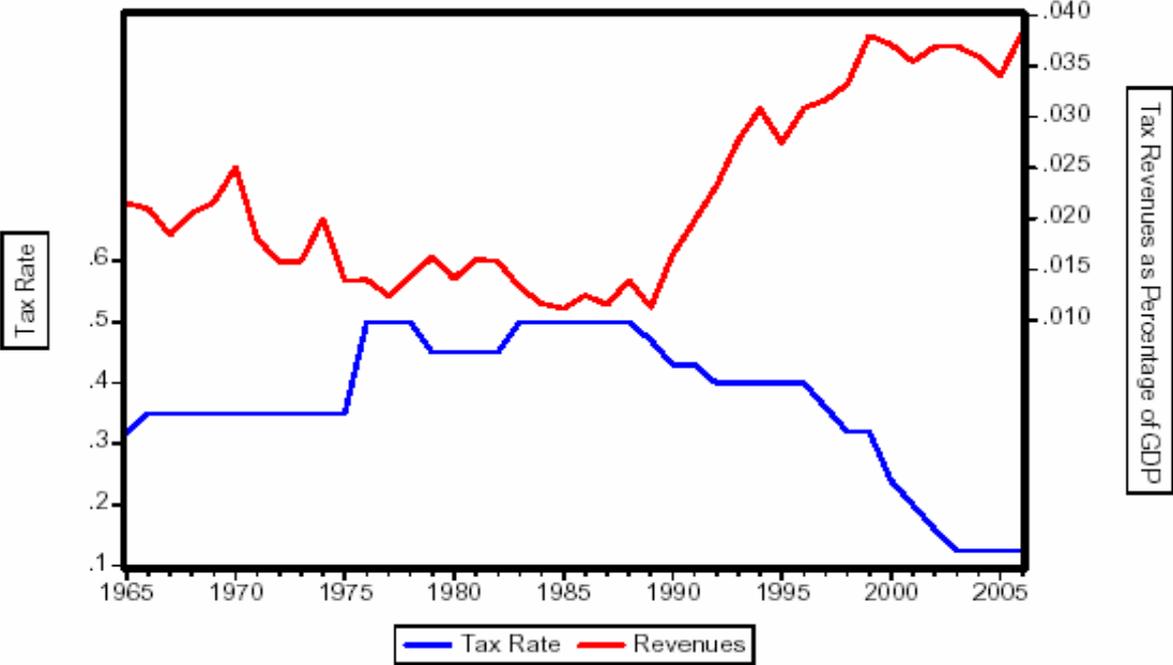


Source: see section 6.1.D, own computations

## 6.2.A Benchmark model

We used the data for Ireland to estimate our benchmark model by OLS given in Equation (2). The results from this estimation are presented in Table 6.1. The TAX variable refers to the corporate tax rate and TAX2 variable refers to the tax rate squared. From the results we can see that both these variables are significant[276] and they do have the expected signs. If we calculate the revenue-maximizing tax rate ($TAX_M$) according to Equation (3), we would obtain $TAX_M = 27,11\%$.

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[276] More precisely we can write that since p-value is less than 0,01 we reject the $H_0$ hypothesis of coefficient of the variable being equal to zero on all important levels of significance (10%, 5%, 1%). Therefore in the folowing text we will refer to those variables as significant. If the significance of some varible would be only on 5% or 10% level of significance it would be mentioned in the text.

**Table 6.1: OLS Estimation of Benchamrk Model**

| Sample: 1965 – 2006 | | | | |
|---|---|---|---|---|
| Included observations: 42 | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| TAX | 0.228443 | 0.017857 | 12.79281 | 0.0000 |
| TAX2 | -0.421323 | 0.041316 | -10.19757 | 0.0000 |
| R-squared | 0.278041 | Mean dependent var | | 0.022220 |
| Adjusted R-squared | 0.259992 | Durbin-Watson stat | | 0.339970 |

Source: own computations

However if we explore the results of the benchmark model more thoroughly, we see that it has several shortcomings. Our explained variable $\left(\dfrac{REV_t}{GDP_t}\right)$ embodies the non-stationarity – it could be seen directly from the Figure 6.2, that it follows some trend and thus the first two moments are not invariant over-time. To confirm this prediction we perform Augmented Dickey-Fuller (ADF) test of unit root.[277] The test statistic in its absolute values $(0{,}191)$[278] do not exceed the tabulated test critical values on all important levels of significance and thus we cannot reject the null hypothesis of presence of unit root. Thus it deepens our suspicion of non-stationarity of explained variable serie.

Moreover, the residuals seem to be autocorrelated. First-order serial correlation is indicated by the Durbin-Watson (DW) statistics[279], which is also represented in Table 6.1. The rule of thumb says that DW statistics should be around two for no serial correlation.[280] If the value is lower than 1,5 than that is a strong indication of positive first-order serial correlation. In our case the value of DW statistics is only 0,34 and thus first-order serial correlation is significantly present in the residuals. The Correlogram of residuals (Q-statistics) also indicates that there is serial correlation in the residuals.

## 6.2.B Adjusted Model

As could be seen from the Figure 6.2 where we have the representation of our benchmark model (actual and fitted values on the right-hand side axis together with residuals

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[277] This test of unit root is based on Dickey & Fuller (1979). More precisely the ADF test was executed using the Akaike information criterion with maximum number of lags being 9 and is implemented in Eviews software. However even if we change this setting (diferent information criterion or maximum number of lags) the results do not significantly differ.

[278] The absolute value of tabulated test critical value at 10% level of significance is 2,605.

[279] This test statistics is based on Durbin & Watson (1951).

[280] See e.g. Johnston & DiNardo (1997), chapter 6.6.1. for thorough discussion about the DW test and a table of significance point of the statistics.

on the left-hand side axis) the residuals do perform steady growth trend. This trend could be the source of the non-stationarity and perhaps even of the autocorrelation of residuals. Therefore we try to include simple linear trend variable to detrend the data and thus remove the non-stationarity from the residuals.

**Figure 6.2: Representation of Benchmark Model**
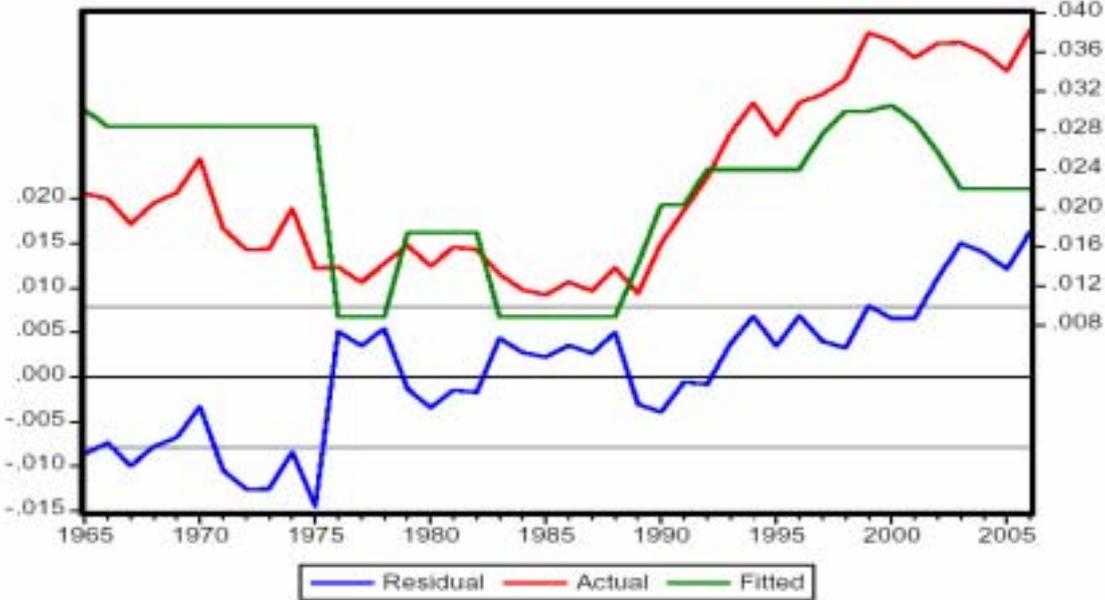


Source: own computations

Moreover we try to include the lagged $\left( \dfrac{REV_t}{GDP_t} \right)$ variable since the autocorrelation could be caused by this rigidity in the explained variable.[281] Moreover, the differences of tax rates were added, however these variables were not significant at any important level and thus they are omitted. The new representation of the model for Ireland is expressed in Equation (4).

$$\frac{REV_t}{GDP_t} = \alpha * TAX_t + \beta * TAX_t^2 + \gamma * TREN + \delta * \frac{REV_{t-1}}{GDP_{t-1}} + \varepsilon_t \quad (4)$$

The results of such a model are presented in Table 6.2. We can see that all the variables are significant. The REV(-1) refers obviously to the lagged explained variable. The tax variables do have their expected signs and thus the shape of the Laffer curve for Ireland

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[281] Other lags (t-2, etc.) were also tried, however they were not significant and thus we do not include them. For the economic explanation of this variable see below.

could be confirmed by this model as well. According to the Equation (3) the revenue-maximizing tax rate is $TAX_M = 25,5\%$, which is not very different from our benchmark model result.[282]

**Table 6.2: OLS Estimation of Adjusted Model for Ireland**

| Sample(adjusted): 1966 – 2006 | | | | |
|---|---|---|---|---|
| Included observations: 41 after adjusting endpoints | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| TAX | 0.052209 | 0.017351 | 3.008920 | 0.0047 |
| TAX2 | -0.102348 | 0.034107 | -3.000802 | 0.0048 |
| TREN | 0.000221 | 5.79E-05 | 3.816767 | 0.0005 |
| REV(-1) | 0.626283 | 0.104812 | 5.975289 | 0.0000 |
| R-squared | 0.932852 | Mean dependent var | | 0.022237 |
| Adjusted R-squared | 0.927408 | Durbin-Watson stat | | 2.366287 |

Source: own computations

## 6.2.C The Properties of Adjusted Model

Now we should examine if we have improved the properties and characteristics of our benchmark model by adding the linear trend and lagged explained variable. Since the trend variable is significant we succeded in detrending the time series. This confirms the ADF test of unit root for residuals. The test statistics in the absolute values (4,259) exceeds the tabulated test critical values on all important levels of significance (the value for 1% level of significance is 3,6) and thus we reject the null hypothesis of presence of unit root on 1% level of significance. The residuals thus do reflect the stationarity in mean as was desired.

The DW statistics (2,37) also indicates that there should be no significant first-order serial correlation in the residuals.[283] This result is confirmed by the correlogram of residuals which rejects also higher-order correlation, since the Q-statistics are not significant at any lag.

To test whether the heteroskedasticity of residuals (nonconstant variance of error-terms)[284] is present we can use the White's test. It basicly regresses the residuals on all other

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[282] Note that we have omitted the lagged $\left( \dfrac{REV_t}{GDP_t} \right)$ term in the computing of revenue-maximizing tax rate.

[283] However the result could be dubious since we included the lagged dependent variable in the model. Thus the DW statistics is biased towards rejecting the significant serial correlation – see e.g. Baltagi (2002), pp. 146-147. On the other hand, also the correlogram confirms the result of no significant first-order correlation.

[284] For introduction to the issue of heteroskedasticity see e.g. Gujarati (2003), pp. 387-440 or Maddala (2001) pp. 199-224.

variables.[285] Since all the p-values in the test are not significant, we cannot reject the null hypothesis of homoskedasticity of residuals and that is also welcomed result.

Jarque-Bera (JB) test of normality of residuals[286] exhibits the p-value of 0,388 and thus we cannot reject the null hypothesis of normally distributed error-terms. Moreover, the $R^2$ and adjusted $R^2$ increased significantly[287] and therefore there is very few information which is not explained by the model adjusted according to the Equation (4).

Thus the adjusted model seems to be appropriate. All the included variables are significant, the residuals exhibit all the neccesary assumtions of the classical regression model and the model explains most of the information.

## 6.2.D Economic Explanation of Added Variables

Since we added the trend variable and the lagged value of dependent variable we should examine their economic meaning in our model. If we focus on the former, it basically says that the revenue to GDP from corporate income tax gradually rised in the examined period (mainly in its second half – see Figure 6.1) independently on the tax rate. It is essential to mention that most of the significance could be explained by the growing **legal tax base** of corporate income tax in Ireland. For example between 1982 and 2005 Ireland reduced tax depreciation rates for investment in plant and machinery rather significantly. The present value of depreciation allowances decreased from 100 per cent to 66 per cent during the mentioned period and this less generous system of allowences obviously contributed to the base broadening.[288] As was already mention the legal tax base is very complex issue, however the trend of base broadening in Ireland was evident.

Another factor partialy explaining the significant trend variable could be the corporate environment in Ireland. The tax rate, *per se,* recorded significant decline in the second period of our examined time period. Moreover, the **overall corporate environment** for companies has improved and that could have attracted the foreign capital and foreign firms to set up a business in Ireland.[289] Thus it obviously attracted also the **shifting of profits**

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[285] See White (1980) for the exact specification of this test. This test is implemented in Eviews software.
[286] This test is based on Jarque & Bera (1987). We have to be aware of the fact that this test is assymptotic (large-sample) and thus for our model the results could be biased. The test is implemented in Eviews software.
[287] The benchmark model was succesfull only for 26% of predicting the values of explained variable according to adjusted $R^2$, however the adjusted model embodies the success in predicting those values in our sample of almost 93%.
[288] See OECD (2007), pp. 24-25 for detailed discussion.
[289] See e.g. http://www.askireland.com/locate.asp for exact information about setting up a business in Ireland and its advantages.

and it encouraged multinationals from other countries to **set up an affiliate** as we have discussed in previous chapter.

Moreover, Ireland accessed the EC in 1973 and that step further simplified the profit shifting and locational issues of multinational corporations. Also Ireland received generous money resources from EC funds and that could have stimulated the corporate sector and improved corporate environment.[290] We cannot forget that this variable could be also partially explained by the non-Laffer indirect factors, which were also shortly discussed in previous chapter.

The significance of the latter variable (lagged value of dependent variable) could be explained by the rigidity of the revenue collection. The companies plans are in the long-term horizont and sudden change in economic conditions thus does not have to have immediate impact on all companies. Therefore there could be some delay in the reaction of companies and thus this rigidity could take place.

## 6.3 France

As a second country to investigate and try to estimate its Laffer curve for corporate income taxation we have chosen France. As in the case of Ireland the data for France are available for the whole period of 1965 – 2006. The sources for the data were described in section 6.1.D.

The statutory corporate income tax rates have been uniform for the whole time period[291] as in the case of Ireland. However, the development of tax rates per se did not represented such great volatility. As you can see from Figure 6.3, where the corporate tax rates and tax revenue as percentage of GDP in France are presented, the tax rate was stable until 1986. Thus in years 1965 to 1986 the corporate statutory tax rate was 50% and since then there was a decline up to year 1993. Since then the tax rate is stable again and it reaches 33,3%.

The development of tax revenue to GDP was relatively stable and it reached its peak in year 2001, when the corporate tax revenue were almost 3,4% of GDP. However, we do not perceive such an upward trend as in the case of Ireland.

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[290] See e.g. http://www.iro.ie/EU-structural-funds.html for a brief evaluation of effects of these EC and EU funds on development of Ireland.
[291] The tax rates do not include local business tax or the turnover based solidarity tax.

**Figure 6.3: Tax Rates and Tax Revenue in France**
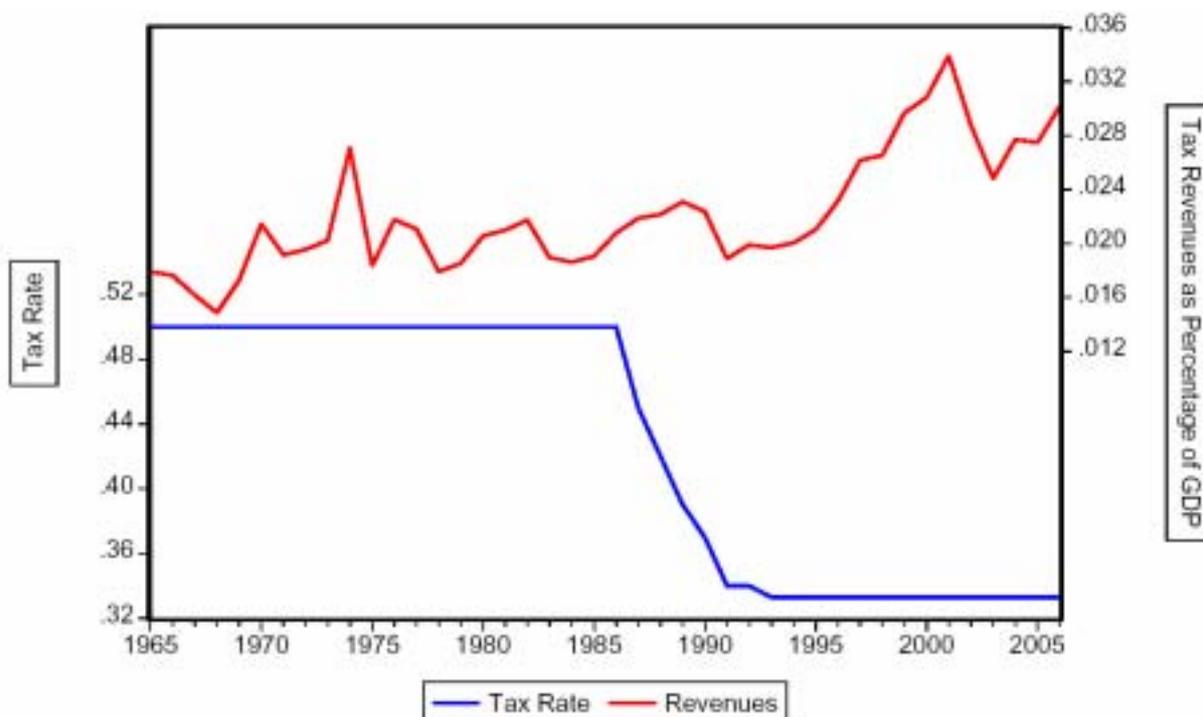


Source: own copmutations

## 6.3.A Benchmark model

The benchmark model given in Equation (2) was again estimated by OLS. The results from this estimation are presented in Table 6.3. From the results we can see that both tax variables (tax rate and tax rate[2]) are significant on all important levels of significance and moreover they possess the expected signs. According to Equation (3) the revenue-maximizing tax rate ($TAX_M$) would be $TAX_M = 33,76\%$.

**Table 6.3: OLS Estimation of Benchamrk Model for France**

| Sample: 1965 2006 | | | | |
|---|---|---|---|---|
| Included observations: 42 | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| TAX | 0.149711 | 0.007953 | 18.82483 | 0.0000 |
| TAX2 | -0.221699 | 0.017262 | -12.84351 | 0.0000 |
| R-squared | 0.408530 | Mean dependent var | | 0.022097 |
| Adjusted R-squared | 0.393744 | Durbin-Watson stat | | 0.662608 |

Source: own computations

As in the case of Ireland we now review the characteristics of this benchmark model for France. The dependent variable again seem to be non-stationary. The test statistic of ADF test of unit root in its absolute values $(1,753)$[292] does not exceed the tabulated test critical values on all important levels of significance. Although the result is much better than in the case of benchmark model for Ireland we still cannot reject the null hypothesis of presence of unit root.

Moreover, the low level of DW statistics $(0,66)$ indicates the presence of first-order serial correlation in residuas. The Q-statistics in Correlogram also indicates the serial correlation in the residuals.

## 6.3.B Adjusted Model

The best suitable way how to deal with serial correlation in residuals in this case would be to incorporate the first-order autoregressive term AR (1) into our model.[293] The AR(1) could be specified as follows: $\varepsilon_t = \rho\varepsilon_{t-1} + \mu_t$, where the $\varepsilon_t$ are the residuals from our benchmark regression.[294]

We further try to include the trend variable to detrend the data, however in the case of France it is not significant and therefore we do not include it into reported results. The difference of tax rates was also added, however likewise in previous case it is not significant and therefore we do not include it. The adjusted model is thus described by the Equation (5).

$$\frac{REV_t}{GDP_t} = \alpha * TAX_t + \beta * TAX_t^2 + \varepsilon_t, \text{ where } \varepsilon_t = \rho\varepsilon_{t-1} + \mu_t \quad (5)$$

The results of a model given by Equation (5) for France are presented in Table 6.4. We can see that all the variables are significant. The AR(1) variable refers to the the first-order autoregressive term. The tax variables again exhibit the expected signs and both are significant and thus the shape of the Laffer curve for France could be confirmed by the adjusted model as well. According to the Equation (3) we can calculate the revenue-

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[292] The absolute value of tabulated test critical value at 10% level of significance is 2,605, we again executed the test using the Akaike information criterion with maximum number of lags being 9. With other specifications the results do not differ significantly.

[293] The lagged dependent variable was also tried, however the the inclusion of AR(1) term brings significantly better results.

[294] For the exact way how the AR (1) term is computed see e.g. Fair (1984), pp. 210-214.

maximizing tax rate which reaches $TAX_M = 34,43\%$, and thus it is again close to our benchmark results.

**Table 6.4: OLS Estimation of Adjusted Model for France**

| Sample(adjusted): 1966 2006 | | | | |
|---|---|---|---|---|
| Included observations: 41 after adjusting endpoints | | | | |
| Convergence achieved after 8 iterations | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| TAX | 0.147185 | 0.017306 | 8.504721 | 0.0000 |
| TAX2 | -0.213770 | 0.037947 | -5.633423 | 0.0000 |
| AR(1) | 0.682717 | 0.124684 | 5.475569 | 0.0000 |
| R-squared | 0.660913 | Mean dependent var | | 0.022199 |
| Adjusted R-squared | 0.643066 | Durbin-Watson stat | | 2.119661 |

Source: own computations

You can also see the representation of our adjusted model in Figure 6.4 (actual and fitted values on the right-hand side axis together with residuals on the left-hand side axis). This figure indicates that the residuals of adjusted model seem to be stationary. Let us now review the properties of adjusted model more thoroughly.

**Figure 6.4: Representation of Adjusted Model for France**
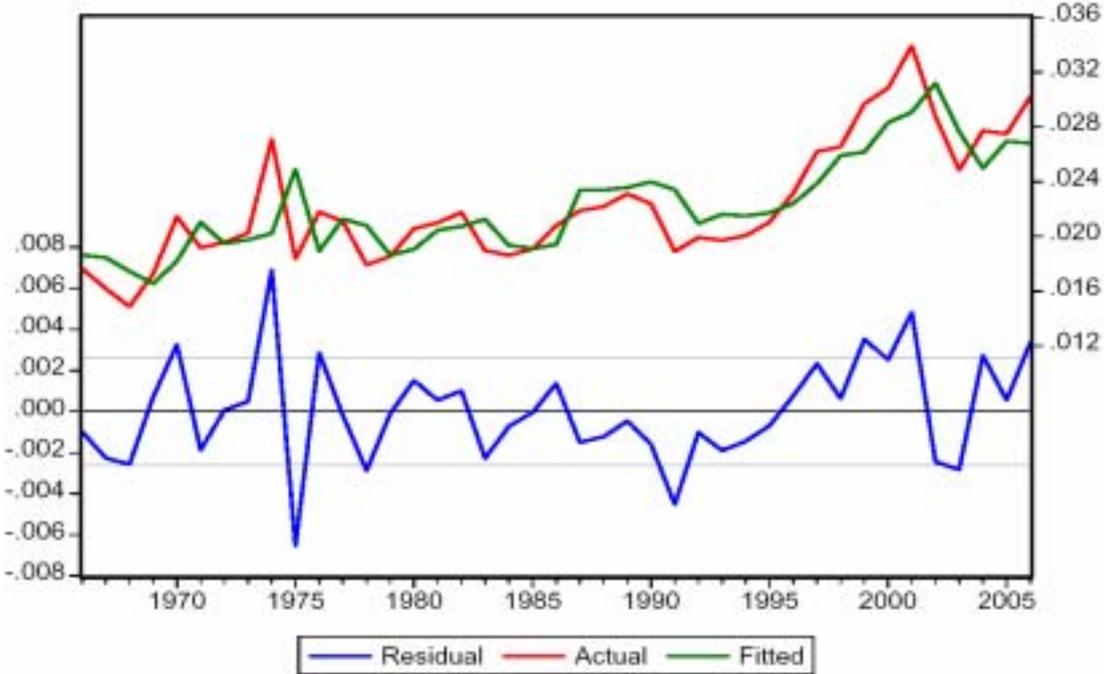


Source: own computations

## 6.3.C The Properties of Adjusted Model[295]

The positive AR(1) coefficient in Table 6.4 indicates that the residuals were positively correlated and it is parallel to the $\rho$ coefficient in Equation (5). Further are thus examined the remainder disturbances ($\mu_t$ in Equation (5)). Our hypothesis about stationarity in mean in residuals is confirmed by the the ADF test of unit root for residuals. The test statistics in its absolute values (6,58) and that exceeds the tabulated test critical values on all important levels of significance. Therefore we can reject the null hypothesis of presence of unit root on 1% level of significance.

When we evaluate the autocorrelation, the DW statistics (2,12) indicates no significant first-order serial correlation in the residuals. The Q-statistics in the correlogram of residuals are not significant at any lag and that rejects also higher-order correlation.

With the use of White's test we can again test the presence of heteroskedasticity. The p-values in the test are not significant and thus we cannot reject the null hypothesis of homoskedasticity of residuals..

When we focus on the normality of residuals, the JB test exhibits the p-value of 0,65, therefore the null hypothesis of normally distributed residuals cannot be rejected. Moreover, the $R^2$ and adjusted $R^2$ increased rather considerably,[296] yet there is some information which is not explained by the adjusted model and that could be the development of legal tax base and other non-Laffer effeects influencing the tax revenue, which were discussed in previous chapter.

This adjusted model is therefore considered to be appropriate, the $R^2$ is reasonably high and the the error terms do exhibit all the neccesary assumtions of the classical regression model

## 6.3.D Economic Meaning of Adjusted Model

In the adjusted model for France we did not include the trend variable. However we do not consider this to be a major problem, since the development of the legal tax base of corporate income taxation in France was probably not that significant as in Ireland. For

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[295] In this case, in the case of United Kingdom and in the panel data model we do not mention the exact references for the used tests (White test, JB test etc.) – see adjusted model of Ireland for those references.
[296] According to adjusted $R^2$ the benchmark model was succesfull for 39% of predicting the values of explained variable, the adjusted model embodies $R^2$ of over 64%.

example the present value of depreciation allowances did not decrease much and thus it did not influence the legal tax base significantly.[297]

The economic interpretation of AR(1) term is rather challenging. We did include this term mainly from the econometric reason. It helped us to solve the issue of positive serial correlation in the residuals. Since the specification of AR(1) term is based on the fact that residuals are correlated with its lagged values, we can try to interpret this term as a kind of sluggishness of tax revenue. They react to the change of parametrs (or to external shock) partially with some delay.

## *6.4 United Kingdom*

As a last country we have selected the United Kingdom. The data available are since year 1970, we were not able to find the data on corporate tax rates in the period of 1965-1969. The sources for the data were described in section 6.1.D. Moreover, we used Her Majesty Revenue & Customs web pages to get the data for tax rates in United Kingdom in earlier periods (1970-1980).[298] The statutory corporate income tax rates were again uniform for the whole time period of 1970-2006.

**Figure 6.5: Tax Rates and Tax Revenue in the United Kingdom**
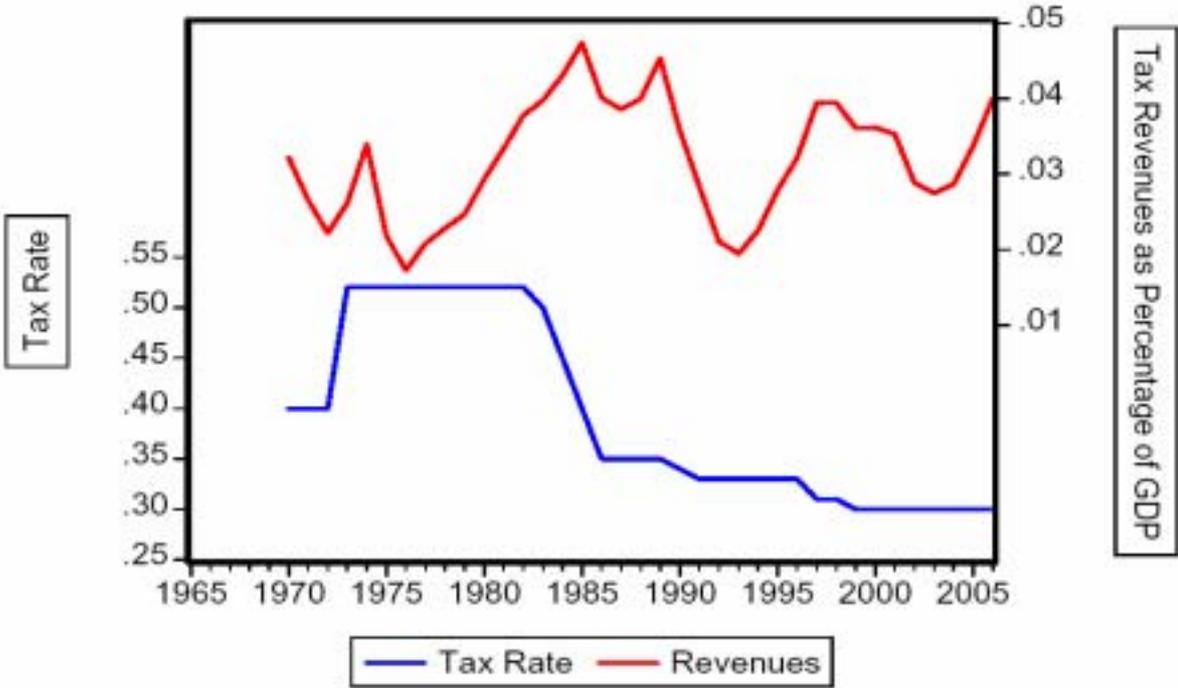


Source:own computations

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[297] See OECD (2007), figure 1.5 on p. 25.
[298] Available at: http://www.hmrc.gov.uk/menus/aboutmenu.htm

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As you can see from Figure 6.5, where the corporate tax rates and tax revenue as percentage of GDP in UK are presented, the tax rate reached 52% in the 1970's and 1980's and then it declined. The statutory tax rate in year 2006 was 30%.

The development of tax revenue to GDP was rather volatile as you can see from the Figure 6.5 and it reached its top in year 1985, when the revenue were around 4,7%. We do not perceive any real trend in the tax revenue data for United Kingdom.

## 6.4.A Adjusted Model

The benchamark model did have similar imperfections as in the case of Ireland and France (mainly the serial correlation in residuals). For the sake of brevity we do not present the results of benchmark model, but we directly consider the adjusted model. We have found out that the best specification for the data of United Kingdom is the model with AR (1) term represented in the Equation (5). Moreover, the difference of tax rates term became not significant and therefore it is not reported. Also the trend variable was not significant. The results of adjusted model for United Kingdom are presented in Table 6.5.

**Table 6.5: OLS Estimation of Adjusted Model for UK**

| Sample (adjusted): 1971 2006 | | | | |
|---|---|---|---|---|
| Included observations: 36 after adjustments | | | | |
| Convergence achieved after 6 iterations | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| TAX | 0.159017 | 0.035288 | 4.506246 | 0.0001 |
| TAX2 | -0.180406 | 0.076113 | -2.370238 | 0.0238 |
| AR(1) | 0.817013 | 0.130546 | 6.258419 | 0.0000 |
| | | | | |
| R-squared | 0.626076 | Mean dependent var | | 0.031755 |
| Adjusted R-squared | 0.603414 | Durbin-Watson stat | | 1.465270 |

Source: own computations

The tax variables again exhibit the expected signs, the tax variable is significant at 1% level of significance and tax$^2$ is significant on 5% level of significance. Thus the shape of the Laffer curve for United Kingdom is confirmed by this adjusted model. The revenue-maximizing tax rate according to our results would be equal to $TAX_M = 44,07\%$. The positive coefficient at AR (1) term again coincides with $\rho$ in Equation (5).

## 6.4.B The Properties of Adjusted Model

Again we would examine the properties of remainder disturbances ($\mu_t$ in Equation (5)). We can reject the null hypothesis of presence of unit root in those disturbances on 1% level of significance. It is because the ADF test statistics in its absolute values $(4,02)$[299] exceeds the tabulated test critical values on all important levels of significance.

When we evaluate the autocorrelation, the result of DW statistics $(1,46)$ is rather dubious. However, the correlogram of remainder disturbances rejects serial-correlation. Moreover if we include the AR(2) term into our model, it is prooved to be not significant.

The presence of heteroskedasticity is again tested by the White's test. All the p-values in the test are not significant, therefore we cannot reject the null hypothesis of homoskedasticity in remainder error terms.

The JB test exhibits the p-value of $0,39$ and therefore the null hypothesis of normally distributed residuals cannot be rejected. The adjusted $R^2$ reaches 60% (in the benchmark model represented by the Equation (2) the adjusted R2 was solely 8%) which is fairly good, however yet there is some information which is not explained by the adjusted model (such as legal tax base developments or other non-Laffer effects in the United Kingdom). Since we reviewed the properties of the adjusted model, it seems to be appropriate specification for United Kingdom.

## 6.4.C Concluding Remarks

In Figure 6.6 you can see the shapes of Laffer curves for corporate income taxation for France and the United Kingdom according to our specification. We do not include Ireland into the graph because of different specification of the model (mainly the term trend), which we would not be able to capture.

We tried to estimate the Laffer effects in three selected OECD countries – Ireland, France and the United Kingdom. We used simple benchmark model and then for each country we tried to find the most appropriate adjusted model. Therefore we have seen that there are different 'best' spefifations for different countries.

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[299] Again the ADF test was executed using the Akaike information criterion with maximum number of lags being 9.

**Figure 6.6: Estimated Laffer Curves for France and UK[300]**
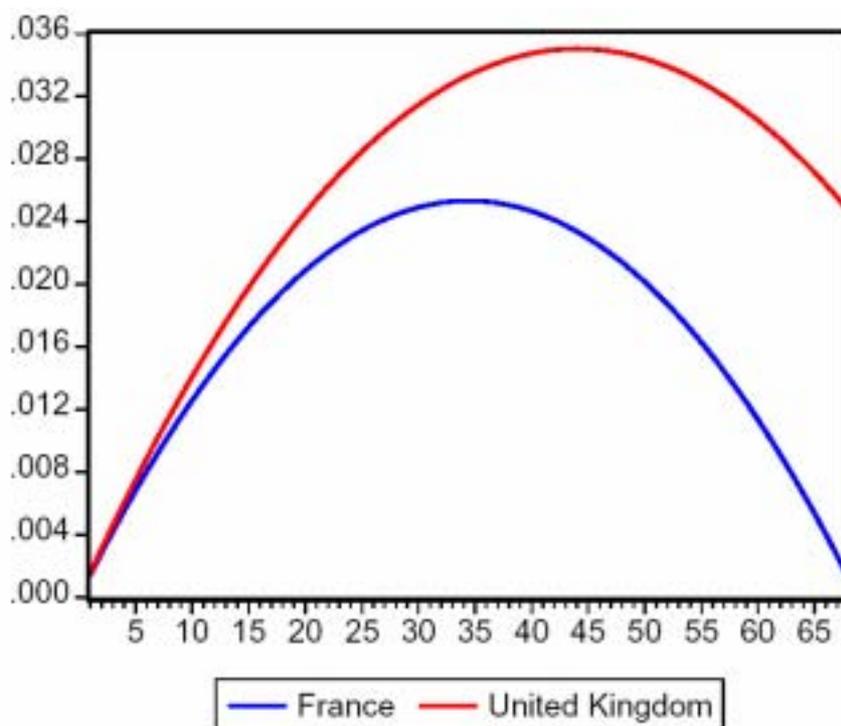


Source: own computations

Our results suggest that the revenue-maximizing tax rate could be around 26% in Ireland, 34% in France and up to 44% in the United Kingdom. Thus we have seen that those rates vary over the selected countries. We can conclude that in each country the tax rates are in its normal area (not prohibitive) of Laffer curve. Although according to our analysis there were some time periods (for example 1970's and 1980's in Ireland) when each of these countries operated in the prohibitive area of Laffer curve and thus the corporate tax rates were excessively high.

Moreover, in the adjusted model the difference of tax rates variable was not significant. However it does not mean, that there is no influence of foreign corporate tax rates on the corresponding tax revenue. It is rather connected with the problems of this variable as were discussed in the first part of this chapter. The unexplained part of the model would attribute mainly to legal tax base variation and to other non-Laffer effects.

Despite the fact, that we have seen that the estimations differ in the countries, we will present a panel data model in the following chapter in order to pool the data for 20 OECD countries together.

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[300] On the x-axis there is corporate tax rate and on the y-axis there are corresponding corporate tax revenue. The revenue are only approximate, because the AR(1) term is not included into these calculations. The more important is the shape of the curves and the revenue-maximizing point.

# 7     Panel Data Model for 20 OECD Countries

In the previous chapter we examined the existence of Laffer curve in three selected OECD countries and we have seen that for each country there is different specification which fits the data the best. However in this chapter we would try to pool the data together for OECD countries and see whether it is possible to estimate the Laffer curve and capture the Laffer effects for corporate income taxation.

## 7.1 Selected Countries and Data Description

As was already mentioned we would examint the panel data of 20 OECD countries for time period 1965 to 2006. There are several reasons why only 20 countries are incorporated into our panel data model and we would briefly discuss them. 4 countries could be classified as post-communist countries (Czech Republic, Hungary, Poland and Slovakia) and for those countries we were not able to find the data until the year 1990. Moreover, the data for earlier periods would probably not be applicable since the communist regimes were conducting the command economy.

Iceland, Republic of Korea, Mexico, Portugal, Switzerland and Turkey were not included into our model because of transparent lack of corporate tax rates data in earlier periods. Therefore in our panel data model we include those 20 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxemburg, the Netherlands, New Zealand, Norway, Spain, Sweden, United Kingdom and the United States.

The sources of the data were already described in section 6.1.D. Moreover we used Her Majesty Revenue & Customs web pages to get the data for tax rates in United Kingdom in earlier periods (1970-1980).[301]

Since we try to include as many observations as possible for our 20 OECD countries we will have unbalanced panel, where some observations are missing. We lack the data for Australia (1976-1979), Austria (1974-1979), Greece (1974-1979), Denmark (1978-1979) and United Kingdom (1965-1969). These data are missing since we were not able to obtain the corporate income tax rates for those countries in the reported years. Moreover, we lack the

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[301] Available at: http://www.hmrc.gov.uk/menus/aboutmenu.htm

data in year 2006 for Australia and Greece, since we were not able to obtain the corresponding tax revenue for that year.

## *7.2 Benchmark Model*

We would proceed as in previous chapter and thus we at first construct simple benchamrk model for the time period of 1965-2006 and report its results. Then we would try to find the best spocification of the model (adjusted model) for our panel data. The simple benchmark model is presented in Equation (6)

$$\frac{REV_{it}}{GDP_{it}} = c_1 * TAX_{it} + c_2 * TAX_{it}^2 + \varepsilon_{it} \qquad (6)$$

$$\text{where} \quad \varepsilon_{it} = \mu_i + \nu_{it}$$

The i subscript stands for the country-specific information and thus range from 1 to 20 (N) and t subscript represents the year and therefore it ranges from 1965 until 2006. We are using the one-way error component model for the disturbances. Therefore, $\mu_i$ denotes the unobservable country-specific effect and $\nu_{it}$ stands for the remainder disturbance.

The other used variables have the same meaning as in previous chapter, only the country-specific subscript is added. We have chosen the fixed effects model[302], where $\mu_i$ are assumed to be fixed parametrs to be estimated, rather than random effects model. The theory suggests that if we have this macro-level data where N is not large as in our case, the proper model to use is the fixed effects model.[303] Also we expect that the remainder disturbances could be correlated as we have seen in the time-series models and this also suggests to use fixed effects model.[304] The results of this panel data with fixed effects model are presented in table 7.1.[305]

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[302] For the way how the fixed effects are constructed see Baltagi (2005), p.12-14.
[303] See e.g. Baltagi (2005), p.12.
[304] See the discussion in Gujarati (2003), pp.650-651.
[305] We had to choose a bit different approach of entering the equation specification into Eviews. If we enter the dependent variable followed by the list of regressors solely, the Eviews would incorporate and compute also the intercept term same for all the countries in the panel and thus it would bias the results. Our goal is to not include the intercept as the theory suggests. Therefore we had to enter the explicit equation such as: REV=C(1)*TAX+C(2)*TAX$^2$ in order to get the results without the intercept term as are presented in our results' tables. Also note that we do not include the country-specific effects into our results' tables.

| Sample: 1965 2006 | | | |
|---|---|---|---|
| Cross-sections included: 20 | | | |
| Total panel (unbalanced) observations: 815 | | | |
| REV=C(1)*TAX+C(2)*TAX2 | | | |
| | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C(1) | 0.167245 | 0.005961 | 28.05572 | 0.0000 |
| C(2) | -0.245697 | 0.014163 | -17.34766 | 0.0000 |
| R-squared | 0.349982 | Mean dependent var | | 0.026545 |
| Adjusted R-squared | 0.333609 | Durbin-Watson stat | | 0.221580 |

Source: own computations

As we can see both the tax variables (coefficients C(1) and C(2)) are significant and have expected signs. If we calculate the revenue-maximizing tax rate ($TAX_M$) according to Equation (3), we would obtain $TAX_M = 34,03\%$.

## 7.2.A Fixed Effects or Simple Pooled OLS method ?

We now should examine whether we need to include the country specific effects and thus if a simple common constant method (pooled OLS method) is not sufficient for our data. We can perform a simple Chow test (F-test) testing for joint significance of the of the added dummies (for individual country effects). Thus the null hypothesis is specified as:

$$H_0 : \mu_1 = \mu_2 = ... = \mu_{19} = 0.$$

The F-test takes this form:[306] $F_0 = \dfrac{(RRSS - URSS)/(N-1)}{URSS/(NT - N - K)} \overset{H_0}{\sim} F_{N-1, N(T-1)-K}$,

where the RRSS stands for restricted residual sum of squares (pooled OLS method) and URSS denotes unrestricted residual sum of squares (fixed effects model). For our model we have N=20, NT=815[307], K=2 and RRSS=0,136, URSS=0,091.[308] The F-statistics critical value is 20,6 and thus the p-value for our specification is 0,00. We therefore can reject the $H_0$ and thus we consider the fixed effects model appropriate for our purposes.

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[306] Taken from Baltagi (2005), p.13.

[307] Note that we have some observation missing and therefore the number of observations is 815 and not 840.

[308] The sum of squares were obtained from the estimation results of corresponding regressions.

However if we have a closer look on our benchmark model results we see that value of DW statistics is rather low and also the correlogram of remainder disturbances (Q-statistics) confirms that we have problem with serial correlation of those disturbances ($v_{it}$).

## 7.3 Adjusted Model

Since there is a problem of serial correlation we try to incorporate the AR(1) term into our equation.[309] Moreover, we also try to include the difference of tax rates variable, however this variable is not significant at any importatn level of significance and therefore for the sake of parsimony of our model, we do not include it into reported results. Thus the proper specification of our adjusted model is specified by Equation (7).

$$\frac{REV_{it}}{GDP_{it}} = c_1 * TAX_{it} + c_2 * TAX_{it}^2 + \varepsilon_{it} \qquad (7)$$

$$where \quad \varepsilon_{it} = \mu_i + v_{it} \quad and \quad v_{it} = \rho v_{it-1} + \xi_{it} \quad (AR\ term)$$

The results of the adjusted model with AR(1) term are presented in Table 7.2. The C(3) variable corresponds to the AR term and thus the estimated coefficient coincides with $\rho$ as is specified in Equation (8).

**Table 7.2: Estimation of Adjusted Panel Data Model**

| Sample (adjusted): 1966 2006 | | | |
|---|---|---|---|
| Cross-sections included: 20 | | | |
| Total panel (unbalanced) observations: 791 | | | |
| Convergence achieved after 12 iterations | | | |
| REV=C(1)*TAX+C(2)*TAX2+[AR(1)=C(3)] | | | |
| | Coefficient | Std. Error | t-Statistic | Prob. |
| C(1) | 0.149873 | 0.015405 | 9.728632 | 0.0000 |
| C(2) | -0.178273 | 0.023054 | -7.732991 | 0.0000 |
| C(3) | 0.936379 | 0.016663 | 56.19624 | 0.0000 |
| R-squared | 0.868536 | Mean dependent var | | 0.026694 |
| Adjusted R-squared | 0.864946 | Durbin-Watson stat | | 1.909733 |

Source: own computations

We can see that all the variables are significantly different from zero and moreover the adjusted model fits the data better (the adjusted $R^2$ increased significantly to 86,5%). The revenue-maximizing tax rate according to Equation (3) would equal to $TAX_M = 42,03\%$.

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[309] See Baltagi (2005), pp. 84-86 for the exact way how the AR(1) term is estimated.

Thus this rate is significantly greater than in the benchmark model. The values of coefficiets should be assymptotically same with the inclusion of AR(1) term. Therefore we can conclude that the AR term improved the quality of the model and the results are thus more efficient (less incorect). The economic interpretation of the AR(1) term would be same as in previous chapter. However, the main reason for inclusion of this term was to solve the problem of serial-correlation.

DW statistics indicates that with inclusion of AR term there should be no other first order serial correlation of our new error terms $\xi_{it}$. This is also confirmed by the correlogram (Q-statistics), which also rejects higher order serial correlation.

On the other hand, the JB test statistics is very high (the reported value is 5762) and thus it exhibits the p-value of 0,0 and we therefore can reject the hypothesis of normally distributed error terms ($\xi_{it}$). From the Figure 5.4 and also from the residual table we see that the country with the most outlier observations is Norway. Thus we try to estimate the adjusted model only for 19 countries without Norway. The results of such a model are presented in Table 7.3.

**Table 7.3: Estimation of Adjusted Panel Data Model without Norway**

| Sample: 1965 2006 IF CROSSID <>16 | | | | |
|---|---|---|---|---|
| Cross-sections included: 19 | | | | |
| Total panel (unbalanced) observations: 750 | | | | |
| Convergence achieved after 2 iterations | | | | |
| REV=C(1)*TAX+C(2)*TAX2+[AR(1)=C(3)] | | | | |
| | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C(1) | 0.137788 | 0.008970 | 15.36089 | 0.0000 |
| C(2) | -0.166729 | 0.016023 | -10.40525 | 0.0000 |
| C(3) | 0.894863 | 0.018758 | 47.70464 | 0.0000 |
| R-squared | 0.854240 | Mean dependent var | | 0.025748 |
| Adjusted R-squared | 0.850241 | Durbin-Watson stat | | 2.062325 |

Source: own computations

As we can see the results are not significantly different from the previous case. All three variables are significant, they have their expected signs and the revenue-maximizing tax rate is equal to $TAX_M = 41,3\%$. There is no other serial correlation in the residuals $\xi_{it}$ (confirmed by DW statistics and correlogram of error terms).

The JB statistics improved a lot (the value reported is 104), but we still reject the hypothesis of normally distributed error terms. However, we do not consider that to be a

major problem and thus we do not perform any transformation which could deviate the results.[310] In the following parts of this chapter we will thus report the results for the whole panel as well as for the panel with 19 OECD countries (without Norway).

## 7.3.A Lagged Tax Rates

We examine our adjusted model for one-period lagged tax variables. The reason to examine this is that the tax rate change might possibly happen in the middle of the year. Moreover, corporate tax revenue could react with a lag to the change in the tax rate – due to some adjustment mechanisms. The adjusted model represented by Equation (7) then slightly modifies to Equation (8).

$$\frac{REV_{it}}{GDP_{it}} = c_1 * TAX_{it-1} + c_2 * TAX^2_{it-1} + \varepsilon_{it} \qquad (8)$$

$$where \quad \varepsilon_{it} = \mu_i + v_{it} \quad and \quad v_{it} = \rho v_{it-1} + \xi_{it} \quad (AR \ term)$$

We do not include both present tax rates and lagged tax rates into one equation because of the problem of multicollinearity which would arise.[311] The results for the whole panel of 20 countries and for 19 countries without Norway are presented in the Table 7.4, where there are reported the values of coefficients, standard errors and P-values. Also adjusted $R^2$, DW statistics and revenue-maximizing tax rate are presented.

**Table 7.4: Estimation of Adjusted Panel Data Model for Lagged Tax Rates**

|  | 20 countries | | | 19 countries (without Norway) | | |
|---|---|---|---|---|---|---|
|  | Coeff. | Std. Er. | Prob. | Coeff. | Std. Er. | Prob. |
| Tax (t-1) | 0,159 | 0,015 | 0,000 | 0,144 | 0,009 | 0,000 |
| Tax2 (t-1) | -0,195 | 0,023 | 0,000 | -0,177 | 0,016 | 0,000 |
| AR (1) | 0,931 | 0,017 | 0,000 | 0,889 | 0,019 | 0,000 |
| Adjusted $R^2$ | 0,865 | | | 0,851 | | |
| DW stat. | 1,928 | | | 2,089 | | |
| TAX_M | 40,80% | | | 40,63% | | |

Source: own computations

The results are as expected, all variables are significant and we do not face the additional problem of serial autocorrelation (as it is confirmed by correlogram of disturbances $\xi$).

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[310] The results of our regression model are valid even with non-normality of residuals. Formally the t-statistics are not precise (confidence intervals are unreliable), however the level of coefficient and their significance are not biased. See e.g. Maddala (2001), pp. 432-433.

[311] See e.g. Maddala (2001), pp. 267-291 for discussion.

Thus we can conclude that since the tax rates do not vary significantly in time, the results with one-period lagged tax rates values are very similar to the adjusted model results.

## 7.3.B Estimations for Different Time Periods

Other intresting aspect could be to examine whether the results are constant through time or whether the shape of the Laffer curve for corporate income taxation was different for different time periods. Therefore we divide our time range into two ten-year and two eleven-year periods (1965-1974, 1975-1984, 1985-1995, 1996-2006). We examine the results of adjusted model represented by Equation (8) in these time periods. The results are reported in the Table 7.5.

**Table 7.5: Estimation of Adjusted Panel Data Model for Time Subsamples**

| | 1965-1974 (20 countries) | | | 1965-1974 (19 countries) | | | 1975-1984 (20 countries) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coeff. | Std. Er. | Prob. | Coeff. | Std. Er. | Prob. | Coeff. | Std. Er. | Prob. |
| Tax | 0,067 | 0,013 | 0,000 | 0,064 | 0,014 | 0,000 | 0,117 | 0,024 | 0,000 |
| Tax$^2$ | -0,032 | 0,031 | 0,303 | -0,023 | 0,032 | 0,482 | -0,141 | 0,051 | 0,006 |
| AR (1) | 0,610 | 0,077 | 0,000 | 0,601 | 0,081 | 0,000 | 0,805 | 0,047 | 0,000 |
| Adjusted R$^2$ | 0,910 | | | 0,906 | | | 0,863 | | |
| DW stat. | 1,782 | | | 1,788 | | | 1,727 | | |
| TAX$_M$ | | | | | | | 41,69% | | |
| | 1975-1984 (19 countries) | | | 1985-1995 (20 countries) | | | 1985-1995 (19 countries) | | |
| | Coeff. | Std. Er. | Prob. | Coeff. | Std. Er. | Prob. | Coeff. | Std. Er. | Prob. |
| Tax | 0,110 | 0,019 | 0,000 | 0,130 | 0,009 | 0,000 | 0,129 | 0,008 | 0,000 |
| Tax$^2$ | -0,132 | 0,042 | 0,002 | -0,161 | 0,021 | 0,000 | -0,161 | 0,019 | 0,000 |
| AR (1) | 0,590 | 0,063 | 0,000 | 0,672 | 0,050 | 0,000 | 0,692 | 0,056 | 0,000 |
| Adjusted R$^2$ | 0,882 | | | 0,816 | | | 0,835 | | |
| DW stat. | 1,667 | | | 1,777 | | | 1,870 | | |
| TAX$_M$ | 41,57% | | | 40,27% | | | 39,98% | | |
| | 1996-2006 (20 countries) | | | 1996-2006 (19 countries) | | | | | |
| | Coeff. | Std. Er. | Prob. | Coeff. | Std. Er. | Prob. | | | |
| Tax | 0,206 | 0,020 | 0,000 | 0,178 | 0,014 | 0,000 | | | |
| Tax$^2$ | -0,249 | 0,049 | 0,000 | -0,218 | 0,040 | 0,000 | | | |
| AR (1) | 0,789 | 0,048 | 0,000 | 0,634 | 0,057 | 0,000 | | | |
| Adjusted R$^2$ | 0,864 | | | 0,795 | | | | | |
| DW stat. | 2,118 | | | 2,070 | | | | | |
| TAX$_M$ | 41,32% | | | 40,66% | | | | | |

Source: own computations

We report the values of coefficients, standard errors and P-values, moreover we include adjusted R$^2$ and DW statistics for every subsample. The estimated coefficient at

AR(1) term corresponds to the $\rho$ from the Equation (8). We also computed the revenue-maximizing tax rate for each estimated model.

There could be several conclusions drawn from our results. The results do not differ much for panel with 20 countries and for panel without Norway. The tax$^2$ variable was not significanty different from zero in the first subsample (1965-1974) and thus we also did not computed the revenue-maximizing tax rate. Therefore the shape of Laffer curve is not such strongly confirmed for that time period.

In all other subsamples all variables are significant and of expected signs. Also there is no major problem with serial correlation as DW statistics and also correlogram of residuals suggest. The revenue-maximizing tax rate does not differ significantly in the different time sub-periods and reaches around 40-41,5%.

Figure 7.1 then shows the estimated Laffer curve for the whole sample of 20 OECD countries for the whole time period and for the last time period 1996-2006.

**Figure 7.1: Estimated Laffer Curves for 1965-2006 and for 1996-2006[312]**
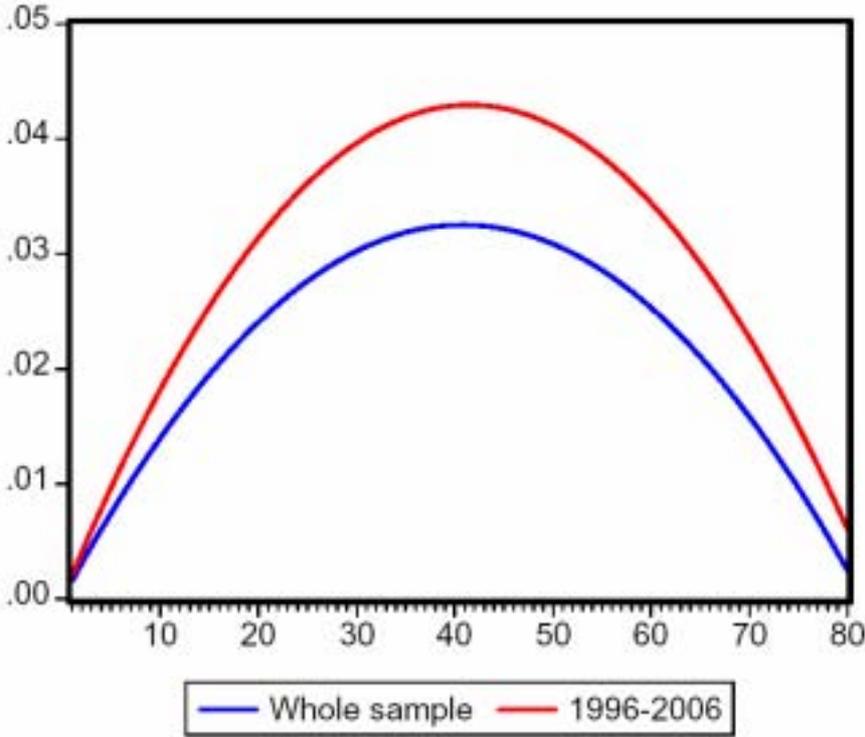


Source: own computations

We can thus draw conclusion that the curve according to our model became steeper in recent years and thus the penalty for being in the prohibitive area has increased.

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[312] On the x-axis there is corporate tax rate and on the y-axis there are corresponding corporate tax revenue. The revenue are only approximate, because the AR(1) term is not included into these calculations.

## 7.3.C Concluding Remarks

In this chapter we have estimated the Laffer curve for corporate income taxation for 20 OECD countries for time period of 1965-2006. We have found the best suitable model is represented by Equation (7) and we estimated that on our panel data using fixed effects. The traditional shape of the Laffer curve was confirmed by our results, only in the first sub-period (1965-1974) the $tax^2$ variable was not significant. We tried to include the difference of tax rates variable in order to proxy for the possibility to shift profits, however this variable was not significant and therefore we did not include it into our model and results. However, this does not say that there are no effects of foreign corporate tax rates on the corresponding tax revenue as was already discussed in previous chapter.

The revenue-maximizing tax rate according to our specification is around 40% to 41% for our sample of OECD countries. Moreover, it seems to be time-invariant. According to this results the selected OECD countries seem to be in its normal are of the Laffer curve, since the statutory corporate tax rates were in year 2006 lower than 40% in all 20 countries. Evidently there were time-periods, when according to our results some countries were in the prohibitive areas of the Laffer curve. The following chapter would summarize our results and further discuss them.

# Conclusions

In this thesis we focused on the issue of Laffer effects and Laffer curve for the corporate income taxation. In first two chapters we discussed the taxation issue in general. The history of taxation was examined in the first chapter and in the following chapter we explored the theory of taxation and tax systems. The emphasis was put on the explanation of the size of the government sector. In folowing chapters we focused on the issue of Laffer curve and Laffer effects. We explored the theory behind the Laffer curve phenomenon and in the consequent chapter we have reviewed the literature on estimation of Laffer curve and (or) Laffer effects.

Three final chapters aimed to identify and estimate the Laffer effects of the corporate income taxation. First the development and its possible explanations of corporate income tax revenue and rates in sample of 20 OECD countries was investigated. We have identified several effects (Laffer and non-Laffer effects), which could positively influence the tax base and thus tax revenue when the corporate income tax is lowered. Then we presented the econometric model and estimated the Laffer curve for three selected countries (Ireland, France and the United Kingdom). In following chapter the Laffer curve was estimated for the whole sample of 20 OECD countries on panel data for the time period from 1965 to 2006.

We can draw several intresting conclusions from our analysis. Foremost, we have **confirmed the traditional shape of the Laffer curve** for corporate income taxation for our sample countries. That is in accordance with our first hypothesis which was stated in the introduction. The panel data estimates would suggest that the revenue-maximizing tax rate is around 41% for our sample countries. This would imply that **none of our sample countries is at the prohibitive range** of the Laffer curve. However, most of the countries were in the prohibitive (inefficient) part of the Laffer curve for some time periods, since their corporate tax rates exceeded 41%. Therefore, factors which influenced the trend in decline of corporate statutory tax rates (they were reviewed in chapter five) resulted in the gain of efficiency from that point of view, since the corporate tax rates seem not to be in their prohibitive areas of the Laffer curve.[313]

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[313] Note that we do not state whether the present corporate tax rates are optimal or they should be lowered or increased. The theory of optimal taxation is a complex issue (see chapter two of this thesis). Our findings solely suggest that we do not observe the present corporate tax rates to be in the prohibitive area of the Laffer curve and thus they seem to be more efficient from that point of view.

Moreover we can conclude that the Laffer effects did play significant role in the development of the corporate tax revenue. On the other hand, since on average the corporate statutory tax rates are more than 10% lower than the revenue-maximizing tax rates in our sample countries and the revenue did not significantly declined in recent years (see Figure 5.3) the **non-Laffer factors** influencing the tax revenue **were also significant**. As such factors we can mention the development of legal tax base, or stricter enforcement of tax laws.

Lastly our analysis in chapter six suggests that if we would like to estimate the Laffer curve for certain country and draw some policy conclusions about the corporate tax rate, we should **use a country-specific estimation**. We have seen that the appropriate model specification could differ for different countries. Moreover, our estimates show that the revenue maximizing tax rate differ significantly across our sample countries (27% in Ireland X 44% in the United Kingdom). Thus, solely the country specific estimation could cover for all the possible specifications of particular countries. Therefore the second hypothesis seems to be correct as well.

Although, our approach has several limitations (those were outlined in chapter six), our results do correspond to results of Clausing and those of Brill and Hassett[314] (however the revenue-maximizing tax rate is little higher in our case than estimated by Brill and Hassett). Further research could for example try to approximate legal tax base and other non-Laffer effects to improve the predicative ability of the used econometric models.

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[314] In Clausing (2007), Brill & Hassett (2007).

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# Internet Resources[315]

**Ask Ireland web page**:

        www.askireland.com

**IMF statistics**:

        www.imfstatistics.org

**Irish Region Office**:

        www.iro.ie

**OECD web page**:

        www.oecd.org

**OECD statistics**:

        stats.oecd.org

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[315] Unless it is stated othervise in the text, the used internet resources listed in the text were checked on 15th of June 2008.