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**RESEARCH AND DEVELOPMENT IN AUTOMOTIVE  
INDUSTRY: COMPARISON OF SWEDEN AND THE  
CZECH REPUBLIC**

VÝZKUM A VÝVOJ V AUTOMOBILOVÉM PRŮMYSLY: KOMPARACE  
ŠVEDSKA A ČESKÉ REPUBLIKY

**MASTER'S THESIS**

DIPLOMOVÁ PRÁCE

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# Master's Thesis Assignment

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Pursuant to Act no. 111/1998 Coll. concerning universities as amended and pursuant to the BUT study Rules, by the Director of the Institute, you have been assigned a Master's Thesis entitled:

## **Research and Development in Automotive Industry: Comparison of Sweden and the Czech Republic**

### **Characteristics of the project issues:**

Introduction  
Goals of Thesis and Methods  
Theoretical Review of Problem  
Analysis of Contemporary situation  
Comparison of Chosen Policy  
Conclusion  
References  
Appendixes

### **The objectives to be achieved:**

The aim of this diploma thesis is to compare the impact of fiscal policy on R & D in the automotive industry between the Czech Republic and Sweden.

### **Literature on the topic:**

EIJFFINGER, Sylvester C. W. a Jakob de HAAN. European monetary and fiscal policy. Oxford [UK]: Oxford University Press, 2000. ISBN 978-0198776161.

MAREK, Dan a Michael J. BAUN. The Czech Republic and the European Union. New York: Routledge, c2011. Europe and the nation state, 14. ISBN 978-0415460972.

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STIGLITZ, Joseph. The Euro: And its Threat to the Future of Europe. Allen Lane: 2016. ISBN-13: 978-024125815

The deadline for submission for the Master's Thesis is given by the Schedule of the Academic year 2018/19.

In Brno, 28.2.2019

L.S.

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Director of the Institute

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Dekan

## **Abstract**

The Master's thesis is focuses on the comparison of the impact of fiscal policy on Research and Development in the automotive industry between Czech Republic and Sweden. Through evaluation of the current situation in the automotive industry, it compares the development in automotive industry with help of indicators that affect it. It also seeks for impulses for improvements in R&D of the Czech Republic and Sweden.

## **Abstrakt**

Diplomová práce je zaměřena na porovnání dopadu fiskální politiky na výzkum a vývoj v automobilovém průmyslu mezi Českou republikou a Švédskem. Vyhodnocením současné situace v automobilovém průmyslu porovnává vývoj v automobilovém průmyslu pomocí ukazatelů, které ho ovlivňují. Hledá také impulsy pro zlepšení v oblasti VaV v České republice a Švédsku.

## **Key words**

automotive industry, innovation, research and development, Sweden, Czech Republic

## **Klíčová slova**

automobilový průmysl, inovace, výzkum a vývoj, Česká Republika, Švédsko

## Extended abstract

Diplomová práce se věnuje srovnání dopadu fiskální politiky na výzkum a vývoj (dále jen VaV) v automobilovém průmyslu mezi Českou republikou a Švédskem. Tyto země se liší v rozsahu, ve kterém se spoléhají na daňová opatření podpory VaV, ale stejně tak v odlišném způsobu daňové úlevy.

V této práci se nebude brát v úvahu velikost podniku ani to, zda je podnik tuzemskou nebo zahraniční fúzí, protože většinu podniků v tomto odvětví vlastní velké mezinárodní korporace.

Česká republika je nejprůmyslovější zemí východní Evropy. Je zřejmé, že ve srovnání se Švédskem má Česká republika nižší ekonomické ukazatele. To je dáno především historickými fakty. Ve srovnání se Švédskem však Česká republika roste mnohem rychleji a je pravděpodobné, že se brzy přiblíží k míře HDP Švédska z roku 2018.

Automobilový průmysl je pro Českou republiku významný jednak z hlediska ekonomické výkonnosti, ale také trhu práce, na kterém je jedním z největších zaměstnavatelů v průmyslu. Výroba automobilů je pro českou ekonomiku klíčová. Automobilový průmysl představuje téměř 25 % průmyslové výroby a vývozu a 7,4 % HDP.

Výkonnost automobilového průmyslu se však na hranicích nezastaví, protože Česká republika je s počtem 118 vozů na 1000 obyvatel jednou z největších světových automobilových velmocí a právem se řadí na 16. místo světového žebříčku s roční produkcí více než 1 milion automobilů. Kromě tří velkých automobilek (Škoda Auto, Hyundai Motor Manufacturing Czech a Toyota Peugeot Citroën Automobile), výrobců autobusů a nákladních automobilů také zahrnuje rozsáhlou a rozmanitou síť dodavatelů. To, spolu se zaměřením řady výzkumných a vývojových subjektů, činí z České republiky kompaktní centrum pro automobilovou výrobu.

K tomu, aby podnik i celý průmysl zůstaly nad vodou, je nezbytný další rozvoj. Spotřebitel se ve svých přáních stává stále více selektivním. Chce mít pouze nejnovější, nejmodernější a ekologicky šetrné zboží. Pro splnění přání klienta musí průmysl

vymyslet něco nového. To je přesně to, o co se snaží výzkum a vývoj: rozvoj nových služeb a produktů či zlepšení stávajících.

**Analytická část** bude obsahovat především internetové zdroje ve formě statistických webových stránek. V této části proběhne porovnání aktivity fiskální politiky ČR a Švédska. Dále bude porovnáván počet automobilů vyrobených v jednotlivých zemích v letech 2007 – 2017 a očekávaný vývoj výroby v následujících letech. Odhadovaný růst a predikce výroby automobilů byly odečteny pomocí statistických metod Excelu. Dále se bude zkoumat zaměstnanost v průmyslu v obou zemích. Podrobněji se práce zaměří na inovační aktivity v České republice a Švédsku. Dále proběhne srovnání počtu podniků, zaměstnanců a tržeb z prodeje v automobilovém průmyslu spolu s celým zpracovatelským průmyslem, a to jak pro podniky, které investují do výzkumu a vývoje, tak i pro podniky, které do něj neinvestují.

**Návrhy na řešení** budou obsahovat doporučení jak vlády ČR a Švédska, tak i malých podniků v České republice a Švédsku.

Automobilový průmysl je jedním z nejvýznamnějších průmyslových odvětví jak ve Švédsku, tak i v České republice, a proto je nezbytné dále rozvíjet a podporovat automobilový průmysl, aby si udržel konkurenceschopnost nejen v Evropě, ale i na globálním trhu. Výrobky z automobilového průmyslu jsou velkou součástí každodenního života celé země.

Zvýšení investic do výzkumu a vývoje by mělo vést ke zvýšení inovací v celém průmyslu.

**Obě vlády České republiky a Švédska by měly:**

*Ve vztahu k Ministerstvu průmyslu a obchodu a příslušným ministerstvům*

Posílit meziřesortní koordinaci činností v oblasti energetické účinnosti, posílit mezivládní kapacitu a zdroje na racionalizaci, plánování, provádění, monitorování a hodnocení vnitrostátních a regionálních politik, ale také i akčních plánů VaV.

*Ve vztahu k podnikatelům*

Uspadnit malým a středním podnikům v České republice a Švédsku větší přístup k financování projektů zaměřených na VaV. Vytvořit další příznivé podmínky pro fungování podniku. Pokles úrokových sazeb pak povede ke zvýšení investic, což má příznivý vliv na podnikatelskou aktivitu. Podnikatelé svou činností racionálně organizují své podnikání a snižují výrobní náklady zavedením nových technologií.

#### *Ve vztahu k daňové politice*

Vytvoření daňových pobídek k cílení produkce komodit na domácí trh a produkci s vysokou přidanou hodnotou zaměřit na vývoz. Rozvoj exportních odvětví na jedné straně přináší příjmy do rozpočtu, na druhé straně přispívá k rozšíření národní produkce a vzniku dalších pracovních míst.

#### **Podniky by měly:**

Jak je uvedeno v druhé části diplomové práce, lze konstatovat, že pouze malý počet podniků investuje peníze do VaV. V současné době se však míra změn v průmyslu zvyšuje. Aby byl podnik konkurenceschopný, musí nejen držet krok s časem, ale také vyvíjet nové produkty. Je to jediný způsob, jak si zachránit své zákazníky. Podniky proto musí vytvořit rozpočtovou položku pro výzkum a vývoj.

Problém však není pouze ve financích. Pro budoucí vývoj jsou zapotřebí odpovídající kvalifikace. Velmi důležitým aspektem je tedy vzdělávání budoucích a současných odborníků. Například Škoda Auto vytvořila vlastní univerzitu, která má za úkol připravovat budoucí odborníky s potřebnou kvalifikací.

Malé podniky by měly alespoň jednou v určitém období své zaměstnance připravit na doškolovací kurzy s cílem aktualizovat své znalosti novými trendy.

Velmi důležitá je také technická stránka této problematiky. Aplikace nových strojů zvýší produktivitu podniku. Samozřejmě, že vzhled nových strojů by měl být doprovázen vhodným školením.

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### **Declaration / Čestné prohlášení**

I declare that this master's thesis is original and has been written independently. I also declare that the list of references is complete and that I did not breach of copyright (in the sense of Act No.121/200 Coll. on Copyright Law and Rights Related to Copyright and on the Amendment of Certain Legislative Acts).

Prohlašuji, že předložená diplomová práce je původní a zpracovala jsem ji samostatně. Prohlašuji, že citace použitých pramenů je úplná, že jsem ve své práci neporušila autorská práva (ve znění Zákona č.121/2000 Sb. o právu autorském a o právech souvisejících s právem autorským).

V Brně dne

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Signature

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## **Introduction**

Master's thesis is based on the comparison of Research and Development in the automotive industry between the Czech Republic and Sweden. Comparison of the development in the industry is made with help of indicators that affect it.

The importance of the automotive industry to the Czech Republic is significant, whether in terms of economic performance or labor market, where it is one of the major employers in the industry. However, the performance of the automotive sector does not stop at the border, as the Czech Republic, with 118 cars per 1,000 inhabitants, is one of the world's automotive superpowers and ranks 16th in the world with annual production of over 1 million cars. In addition to three major automakers (Škoda Auto, Hyundai Motor Manufacturing Czech, Toyota Peugeot Citroën Automobile), bus and truck manufacturers, it includes a vast and diversified network of suppliers. This, together with the focus of a number of R&D and design entities, makes the Czech Republic a compact center for automotive production.

Car production is crucial for the Czech economy. The automotive sector accounts for almost 25% of industrial production and exports, and 7.4% of GDP.

In order for the enterprise as well as the whole industry, to remain afloat further development is vital. Consumer becomes more and more selective in its desires. He wishes to have only the latest, most trendy, environment-friendly goods. To calm the client's desires industry needs to invent something new. This is exactly what Research and Development does: developing new services and products, or improving existing ones.

## **The Aims and Methodology**

The main aim of this Master's Thesis is to compare the impact of fiscal policy on R & D in the automotive industry between the Czech Republic and Sweden.

In this work I will not take into account the size of the enterprise nor whether the enterprise is a domestic or foreign affiliate, since most of the enterprises in this industry are owned by large international corporations.

In the theoretical part of the thesis two sources of the information will be used: these are internet sources as well as specialized literature. This part will introduce us to theoretical information about the automotive industry, the energy intensity, economic policy of Sweden and Czech Republic, Research and Development.

The analytical part will contain mainly internet resources in the form of statistical website. In this section, I will compare country fiscal policy activities of The Czech Republic and Sweden. Furthermore, the number of cars produced in each country in 2007-2017 and the expected development of production in the coming years. The estimated development growth and the prediction of car production was deducted using Excel statistical methods. Next I will examine industry's employment in both countries. I'll take a closer look to innovation activities in the Czech Republic and Sweden. I will also compare the number of businesses, employees, and revenues sales in the automotive industry with the entire manufacturing industry, both for enterprises that invest in Research and Development and enterprises that do not invest in it.

Own suggestions will include recommendations both the government of the Czech Republic and Sweden as well as for small enterprises in the Czech Republic and Sweden.

# **1. Theoretical part**

This part will introduce us to theoretical information about the automotive industry, the energy intensity, economic policy of Sweden and Czech Republic, Research and Development.

## **1.1 Macroeconomic Overview**

A study of economic policy requires knowledge of basic macroeconomic indicators. Thus in the first part I have described selected indicators, which will be used in the practical part for calculations. Such indexes are useful as an 'objective' economic comparison and indicators of different macroeconomic behavior between countries. Macroeconomic indicators themselves deal with the performance, structure, behavior and decision-making process of an entire country's economy.

Macroeconomic models explain relationship of the economy functions such as investments, trading and economic policies. Such types of models are used to support the establishment and evaluation of economic policies and business strategies. The indicators I selected are supposed to reflect the different statuses, approaches, behavior and goals of governments and nations, relevant to international comparison

### **1.1.1. Gross domestic product**

Warfare is the mother of invention. Many of technologies which are in use nowadays were invented by the military as demands of conflict. Among these inventions, from telephone, radio, medicines, sublimated fast-food to Internet and Smartphone, is Gross Domestic Product. GDP is one of the many inventions of World War II (3, p.7)

Gross domestic product, or GDP, is often considered the best measure of how well the economy is performing. This statistic is computed every three months by the Bureau of Economic Analysis, a part of the U.S. Department of Commerce, from a large number of primary data sources. The primary sources include both administrative data, which are by-products of government functions such as tax collection, education programs, defense, and regulation, and statistical data, which come from government surveys of,

for example, retail establishments, manufacturing enterprises, and farm activity. The purpose of GDP is to summarize all these data with a single number representing the dollar value of economic activity in a given period of time (3, p.13-15).

GDP is the primary indicator which shows economic standard of a given country. It reveals us the total income or expenditure on its output of goods and services. There are **nominal** (current) and **real** (inflation-corrected) products. The final calculation can be accomplished using three methods (9, p. 192):

- income method (the sum of all wages of labor, profits of enterprises, land rents and capital interests)
- expenditure method (private/household consumption + gross investment + government spending + (exports – imports))
- output method - measure of GDP which adds together the value of output produced by each of the productive sectors in the economy using the concept of value added.



Figure 1 European Union GDP growth rate 2012-2016 (Source: 31).

In international comparisons is used GDP per capita (a frequent indicator of economic standard). It is an approximation of the value of goods produced per person. In other words, country's GDP divided by the total number of people in the country. In some countries, Gross National Product (GNP) is considered as more important (especially in those with high share of enterprises overseas). Difference is that the final value is

generated only by country's owned factors (national owners), but in both country's area and overseas (10, p20).

## **1.2 Energy intensity**

Energy intensity is the ratio between gross domestic energy consumption (GIEC) and gross domestic product (GDP), calculated for a calendar year. GIEC is calculated as the sum of the gross inland consumption of the five energy sources: oil, gas, renewable sources, solid and fuels. To monitor trends, GDP is in constant prices to avoid the impact of inflation, with a base year of 2010 (32).

Energy-intensity is expressed as the ratio between gross inland energy consumption and GDP.

Historically economic growth has been accompanied with growth of energy consumption, increasing the pressure on the environment. Energy intensity identifies to what extent there is decoupling between energy consumption and economic growth. Relative decoupling becomes when energy consumption grows, albeit more slowly than the economy (i.e. GDP). Absolute decoupling appears when energy consumption is stable or falls while GDP grows. It is likely that absolute decoupling will lower the pressure on the environment from the energy production and consumption.

### **Environmental context**

Separating energy consumption from economic growth can help to achieve economic and environmental goals. One of the ways to lower the energy intensity is to reduce the demand for energy services (e.g. heating, lighting and passenger or freight transport) by using new types of energy or using classical energy in a more efficient way (thereby using less energy per unit of economic output). From an environmental point of view, overall impacts depend on the total amount of energy consumption, and the fuels and technology used to generate the energy.

Gross inland energy consumption is measured in 1 000 tones of oil equivalent (ktoe), while GDP is expressed in millions of Euros at 2010 market prices. To make

comparisons of trends across countries more meaningful, the indicator is presented as an index (32).

### 1.3 NACE-codes

NACE (Nomenclature of Economic Activities) is the European statistical classification of economic activities. NACE groups organizations according to their business activities. Statistics produced on the basis of NACE are comparable at European level and, in general, at world level in line with the United Nations' International Standard Industrial Classification (ISIC). The change in the identification and grouping of similar economic activities associated with the move to the new NACE implies a statistical break in the time series (38).

The NACE code is subdivided in a hierarchical, four-level structure. The categories at the highest level are called sections. The first two digits of the code identify the division, the third digit identifies the group, and the fourth digit identifies the class.

Table 1 contains a list of countries that use the NACE-codes. The use of NACE is mandatory within the European statistical system (38).

**Table 1: Countries that use NACE Codes.** (Source: 38).

<b>AT</b>	<b>Austria</b>	<b>IE</b>	<b>Ireland</b>
<b>BE</b>	Belgium	<b>IT</b>	Italy
<b>BG</b>	Bulgaria	<b>LT</b>	Lithuania
<b>CY</b>	Cyprus	<b>LU</b>	Luxembourg
<b>CZ</b>	Czech Republic	<b>LV</b>	Latvia
<b>DE</b>	Germany	<b>MT</b>	Malta
<b>DK</b>	Denmark	<b>NL</b>	Netherlands
<b>EE</b>	Estonia	<b>PL</b>	Poland
<b>EL</b>	Greece	<b>PT</b>	Portugal
<b>ES</b>	Spain	<b>RO</b>	Romania
<b>FI</b>	Finland	<b>SE</b>	Sweden
<b>FR</b>	France	<b>SI</b>	Slovenia
<b>HR</b>	Croatia	<b>SK</b>	Slovak Republic
<b>HU</b>	Hungary	<b>UK</b>	United Kingdom

NACE code allows the comparability of statistics produced in different statistical domains (ISIC, CPC, HS, CPA, CN, and PRODCOM). It is required to include a NACE code description of organization's activities on the Environmental Management Systems application form for registration purpose.

Table 2 shows 1<sup>st</sup> level division of economic activities in the European Community according to NACE classification.

**Table 2: Statistical Classification of Economic Activities in the European Community Rev. 2 (2008): Level 1 Codes** (Source: 38).

Code	Economic Area
<b>A</b>	Agriculture, Forestry and Fishing
<b>B</b>	Mining and Quarrying
<b>C</b>	Manufacturing
<b>D</b>	Electricity, Gas, Steam and Air Conditioning Supply
<b>E</b>	Water Supply; Sewerage, Waste Management and Remediation Activities
<b>F</b>	Construction
<b>G</b>	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles
<b>H</b>	Transportation and Storage
<b>I</b>	Accommodation and Food Service Activities
<b>J</b>	Information and Communication
<b>K</b>	Financial and Insurance Activities
<b>L</b>	Real Estate Activities
<b>M</b>	Professional, Scientific and Technical Activities
<b>N</b>	Administrative and Support Service Activities
<b>O</b>	Public Administration and Defence; Compulsory Social Security
<b>P</b>	Education
<b>Q</b>	Human Health and Social Work Activities
<b>R</b>	Arts, Entertainment and Recreation
<b>S</b>	Other Service Activities
<b>T</b>	Activities of Households as Employers; Undifferentiate Goods and Services Producing Activities of Households for Own Use
<b>U</b>	Activities of Extraterritorial Organisations and Bodies

## Section C: Manufacturing.

This section includes the physical or chemical transformation of materials, substances, or components into new products. The materials, substances, or components transformed are raw materials that are products of agriculture, forestry, fishing, mining or quarrying as well as products of other manufacturing activities. Substantial alteration, renovation or reconstruction of goods is generally considered to be manufacturing.

**Table 3: Statistical Classification of Economic Activities in the European Community Rev. 2 (2008): Level 2: C-code Manufacture (Source: 38).**

C	Manufacture
C10	Manufacture of food products
C11	Manufacture of beverages
C12	Manufacture of tobacco products
C13	Manufacture of textiles
C14	Manufacture of wearing apparel
C15	Manufacture of leather and related products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31	Manufacture of furniture
C32	Other manufacturing
C33	Repair and installation of machinery and equipment

Manufacture of specialised components and parts of, and accessories and attachments to, machinery and equipment is, as a general rule, classified in the same class as the manufacture of the machinery and equipment for which the parts and accessories are intended.

Table 3 provides a 2<sup>nd</sup> level classification division in the sub-category C: Manufacturing.

NACE code for the automotive industry is C-29: Manufacture of motor vehicles, trailers and semi-trailers.

This division includes the manufacture of motor vehicles for transporting passengers or freight. The manufacture of various parts and accessories, as well as the manufacture of trailers and semi-trailers, is included here. The maintenance and repair of vehicles produced in this division are classified in 45.20.

## **1.4 Economic policy**

A system that relies on the results and recommendations of the economic theory, however elaborated in specific social and political conditions. That is why it must to accept the basic principles and standards of the country's political system. Observed economic objectives it must be compatible with the set of other policy objectives pursued. Therefore the practical recommendations of economic policy are not as straightforward as their individual theoretical ones concept and especially not as a recommendation of economic theory that is not politically bound responsibility. Most factors of economic policy can be divided into either fiscal policy, which deals with government actions regarding taxation and spending, or monetary policy, which deals with central banking actions regarding the money supply and interest rates (13, p.210).

Such policies are often influenced by international institutions like the International Monetary Fund or World Bank as well as political beliefs and the consequent policies of parties.

The subject of economic policy can be defined as a sum of economic, political and economic factors, social relations related to the development of the economy of that

state. Economic policy represents, in relation to politics, the instrument of realizing the goal of political power in areas of the functioning of the economic system. In the policy area, economic policy focuses primarily to analyze and create the environment in which economic policy is being implemented in particular the possibilities and constraints arising from the socio-political arrangement, analyzes the influence of political power, the influence of interest groups on the creation and realization of economic policy (15, p. 275-276).

In relation to the economy, economic policy analyzes the development trends in the economy and elaborates long-term strategic objectives of economic development. It also analyzes the causes of the malfunctions in the development of the economy, elaborates variant proposals for solving specific economic situations, offers a set of appropriate tools to reach the goals and coordinate economic goals activities of non-state economic subjects (9, p.386).

In its policies, economic policy relies on knowledge of economic theory, above all macroeconomics and microeconomics, and it also uses knowledge from the development of economic thinking. It also uses the knowledge of related sciences to meet the objectives set disciplines, namely: political, social, legal, but also exact sciences such as statistics, mathematical analysis and modeling.

The subject of economic policy is above all the state and the government as the state representative and all government authorities and institutions, in accordance with the powers and responsibilities assigned (e.g. ministries, labor offices, tax offices, cadastral offices) (10, p.131).

However, it should be recalled that there is a whole range of others in pluralist society of domestic entities involved in both the creation and the implementation of economic policy. Moreover, under the conditions of the open economy, transnational entities enter this area, which significantly determine the creation and implementation of economic policy (such as international organizations, transnational authorities).

The subjects of economic policy are cleared by their share in the economic policy decision-making and the level at which they act. This includes in particular:

- the decision-making sphere, the state and the constituent of state power and administration, i.e. parliament, governmental institutions, and others institutions such as a central bank, a judicial institution.
- establish a sphere, the so-called bearers of influence and it is formed, for example, by a trade union, political parties, scientific institutions, lobby, large enterprises, chambers, interest organizations.
- a transnational organization, including transnational levels in integration groups.

The subject of economic policy can be defined as a sum of economic, political and economic factors social relations related to the development of the economy of that state.

#### **1.4.1 Goals of economic policy**

Maximizing social welfare is generally recognized as the ultimate economic goal policies but cannot be specified. Basic social values appear in most economic policy agenda, but they cannot even infer binding goals for a practical one economic policy. This task fulfils the so-called traditional economic policy objectives, among which most often we find these four goals (13, p.212):

- sustained and appropriate economic growth, indicated and measured by gross premiums domestic product.
- permanent price level, indicated and measured by the percentage increase in price level, inflation rate.
- sufficiently high employment, indicated and measured by the unemployment rate.
- external economic equilibrium, indicated and measured by the surplus of the trade balance, the share of external benefits to gross domestic product.

These economic policy objectives aim at preserving internal and external economic policies balance.

The goal of any country's government is to increase GDP so that low unemployment is low inflation so as not to be too large a balance of payments deficit.

The magic quadrangle (Figure 2) looks at the relationship between the four economic indicators (16, p. 83):

- unemployment,
- Continuous economic growth (GDP)
- balance of trade balance
- inflation

Fulfillment of all four indicators is not possible if two of these indicators improve, the other two will get worse.

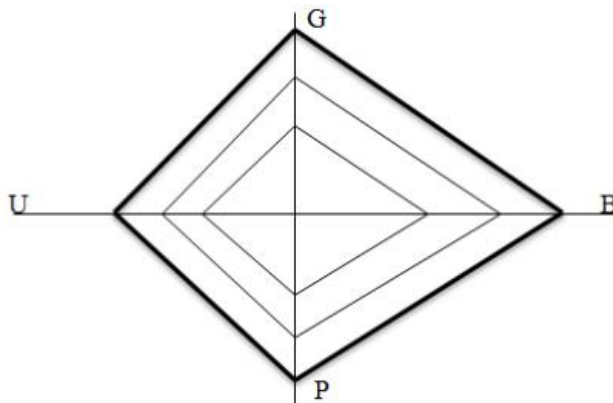


Figure 2: Magic Quadrant (Source: 16, p.83).

a) GDP

Gross domestic product is the volume of goods produced and services provided in the economy the country for a certain period (usually one year).

b) Inflation

Inflation is a process of gradual currency depreciation due to price increases. It is the cause depreciation of the purchasing power of money, reduction of real wages and thus

all overall economic instability. Economists distinguish between several degrees of inflation, according to their size (moderate, hyperinflation).

#### c) Unemployment

The population is divided into economically active and economically passive. The first group consists of people employed, or people who are actively looking for or wanting to return after temporary job exclusion. The second group is people who are unemployed and do not actively seek work.

#### (d) Balance of foreign trade

Balance, i.e. difference, trade balance (exports and imports) - distinguish between active and passive. At the active balance of exports exceeds imports (payments from abroad are higher than payments to abroad). In the passive balance it is the opposite. With repeated passive balances, it grows and grows state debt (16, p.84).

### **1.4.2 Economic Policy Instruments**

Economic instruments are fiscal and other economic incentives and disincentives to incorporate environmental costs and benefits into the budgets of households and enterprises.

The objective is to encourage environmentally sound and efficient production and consumption through full-cost pricing. Economic instruments include effluent taxes or charges on pollutants and waste, deposit-refund systems and tradable pollution permits (34).

Several aspects can be applied to the division of the process (practical) economic policy instrument. For the decisive aspect is considered to be the mode of action of the given instrument to develop the relationship between economic process participants.

From this point of view, we can divide the practical economic policy instruments directly working tools (direct tools) and tools that are impractical (indirect tools). Directly acting tools, direct tools, are tools by which they are commissioned or commissioned institutions are directly involved in shaping economic processes, often as

well as their immediate party. The use of direct instruments makes it possible to influence the behavior of economic operators so that they are directly dependent on the tools applied. Failure to respect these tools is then associated with the application of the corresponding sanctions that arise from valid legislative ones the standards that these instruments rely on. Applying these tools in market conditions coordinated economy has a short-term and selective nature. They are mainly used in when other economic policy instruments became ineffective.

In general, the possibility of influencing economic development by means of instruments is recognized define policy (13, p.321):

- Monetary policy - regulation of money supply, influencing interest rates and in relation to demand for money generating the amount of money in the economy.
- Fiscal policy - State budget, revenue, expenditure, regulation.
- Retirement policy - Voluntary wage and price guidelines, mandatory regulation.
- International trade policy - trade balance, balance of payments, currency courses

Macroeconomic policy chooses among the main alternative objectives of the economy. No country can simultaneously have high consumption and rapid growth. For example, an effort to reduce high rates of inflation will require either a period of relatively high unemployment rates, and low product levels, or state intervention into the free market by wage and price policies. These difficult choices must be made by makers of macroeconomic policies in each country.

On the contrary, if a country wishes a low unemployment rate with a 1-level product that is moves high above its potential product, must count with a fairly significant level inflation rates.

However, other macroeconomic dilemmas are also behind maker macroeconomic policy makers. Temporarily the country can keep inflation at a lower level, subject to wage and price regulation, the result is price strain and low economic efficiency. Increase growth rate potential product requires greater investment in capital but also in knowledge, i.e. increase qualification of workers. But if the economy with high employment invests more, it has there is, of course, less consumption, that is, fewer

products and services. It is a difficult choice for those who macroeconomic policy is, in every country, also a highly developed country (10, p.128).

### **1.4.3 Types of economic policy**

Depending on how they respond to the above question, how do they deal with the relationship between the market mechanism and state regulation and what weight they place on economic stabilization targets policies, historical types of economic policies have been created.

Studying the economic role of the state is accompanied by constant contradiction between the classical one (neo-classical, neoconservative, monetarist) and Keynesian (neo-keynesian, post-keynesian) approach to macroeconomic problems. I will at least briefly explain the essence of the difference between the two directions of economic thinking that form the theoretical basis different practical economic policies.

### **1.4.4 Time lags**

In economics we often see a delay between an economic action and a consequence. This is known as a time lag. An impact of time lags is that the effect of policy may be more difficult to quantify because it takes a period of time to actually occur.

There are four main channels which can cause time lags in economics (10, p.447):

- Change in interest rate (as macroeconomic level)
- Increase in level of investment (as macroeconomic level)
- Change in price of commodity (as microeconomic level)
- Effect of devaluation or J-Curve effect (as macroeconomic level)

#### **Changes in interest rate.**

Cutting interest rates is expected to cause a rise in investment and consumer spending due to cheapening of loans and less attractive saving motives. Therefore lower interest rates should lead to higher aggregate demand.

However, there may be time lags for following reasons (9, p.391):

- uncertainty if the interest rates are changed permanently or temporarily.
- fixed interest rates on saving accounts or on loans, i.e. it will take time to change interest rates to actual ones.
- new projects or projects in process of expand. Whilst project is already started it is unlikely to stop despite of growing rates as closing the project will bring to bigger loss than the loss caused by changing rates. However, over time, the higher interest rates may prevent future investment projects from being undertaken.
- economic illiteracy of the population. Consumers don't have perfect knowledge. They may not check interest rates every month, but only become aware after a certain time.

### **Effect of investment**

An important source of lags comes from the response of investment - both consumer investment and business investment in durables and dwellings - to changes in monetary policy. Changes in interest rates also affect intention to postpone investment when returns are uncertain. The largely irreversible nature of many investments means that there is an option value to waiting to invest in a world of uncertainty. Unchangeable investment of a enterprise or an individual eliminates the possibility of waiting for the new information that might have affected the timing or the importance of the investment. A change in interest rates affects this option value, and will, therefore, affect the timing of the investment (4, p.9).

### **Change in price of commodity**

In short-term period rising of the price does not cause big changes as demand is often price inelastic. This is because consumers are in the habit of buying the good and are less aware of alternatives.

However, if the price rise is permanent, they may start to make more effort to look for alternatives. Therefore, over time, demand often becomes more price elastic (8, p.113).

When the price of petrol tripled in the mid-1970s, demand was initially very price inelastic. People with petrol cars still needed to get to work. However, over time,

consumers and producers respond to this change in price by developing more fuel efficient cars or even buying an electric car. Over-time, demand has become more price elastic for petrol.

### **J-Curve effect**

The J-Curve effect states that the impact of devaluation will vary as time progresses. Devaluation makes imports more expensive, and on the assumption that the volumes of imports and exports change little at first, this causes a fall in the current account (a bigger deficit or smaller surplus). However, in the long-term, demand for exports is more price elastic, so the volume of exports may start to rise because of their lower and hence more competitive prices to foreign buyers, and domestic consumers may buy fewer of the costlier imports.

Eventually, if this happens, the trade balance should move to a smaller deficit or larger surplus compared to what it was before the devaluation. Likewise, if there is a currency revaluation or appreciation the same reasoning may be applied and will lead to an inverted J curve (7, p. 238).

## **1.5 Europe 2020 strategy**

The Europe 2020 strategy is the EU's agenda for growth and jobs for the current decade. It emphasizes smart, sustainable and inclusive growth as a way to overcome the structural weaknesses in Europe's economy, improve its competitiveness and productivity and underpin a sustainable social market economy (32).

### **Targets:**

#### Employment

- 75% of people aged 20–64 to be in work

#### Research and development (R&D)

- 3% of the EU's GDP to be invested in R&D

#### Climate change and energy

- greenhouse gas emissions 20% lower than 1990 levels
- 20% of energy coming from renewables
- 20% increase in energy efficiency

#### Education

- rates of early school leavers below 10%
- at least 40% of people aged 30–34 having completed higher education

#### Poverty and social exclusion

- at least 20 million fewer people in – or at risk of – poverty/social exclusion

#### **Features of the targets**

Targets show of where the key parameters should be in EU by 2020. These targets are translated into national goals for each EU country to check its own progress towards each goal. Achievement of the goals is to be made through a mix of national and EU actions.

All of the targets are interrelated and mutually reinforcing

- educational improvements help employability and reduce poverty
- R&D/innovation and more efficient energy use makes us more competitive and creates jobs
- investing in cleaner technologies combats climate change while creating new business or job opportunities.

The strategy is monitored by Eurostat, which regularly publishes results and reports. European Commission recommends that individual EU objectives be translated into national targets in order to be the best country-specific needs. The EU has also responded to the emergence of Sustainable Goals development of the UN in 2015 and the implementation of individual objectives in EU policy.

Current situation for the EU shows a rather mixed picture. Substantial progress has been made in the areas of climate change and energy, as well as in education. However, there

is still some way to go to meet the targets on R&D investment, employment and poverty alleviation, although more recent developments for the latter two are promising (32).

## **1.6 Economic policy of the Czech Republic**

Among all the post-communist states, the Czech Republic has one of the most stable and successful economic systems. Its basis is the industry (mechanical engineering, electrical engineering and electronics, chemistry, food industry and ferrous metallurgy), construction and services. The share of agriculture and forestry, as well as the mining industry is insignificant and continues to decrease (11, p. 119).

After the fall of socialism in 1989, the Czech Republic inherited from Czechoslovakia the former structure of the economy, which in the new conditions turned out to be energetically inefficient, non-ecological, outdated and inadequate from a sectoral point of view. A disproportionately large share was taken by ferrous metallurgy on imported raw materials, heavy engineering and military industry. The range of goods produced significantly exceeded the objective possibilities of the country, which led to small-scale production and a decrease in its efficiency. Foreign trade was subject to the directives of the CMEA, focused on the needs of the USSR and was insignificant compared to other developed countries (11, p. 95).

Czech Republic falls into the middle ranks in terms of economic policies. Thanks to strong export performance and high consumer spending, growth rates are among the strongest in Europe. However, Czech economy is highly reliant on European Union funding. A relaxation of euro-pegged exchange rates helped restrain inflation, and may make euro adoption easier (11, p.142).

According to the Maastricht Treaty, the Czech Republic is bound to adopt the euro in the future and to join the eurozone once it has satisfied the euro convergence since it joined the European Union (EU) in 2004. The Czech Republic is therefore a candidate for the enlargement of the eurozone and it uses the Czech koruna as its currency, regulated by the Czech National Bank, a member of the European System of Central Banks, and does not participate in European Exchange Rate Mechanism II (ERM II) (17, p. 278).

Unemployment rates are very low (2.5%, aug2018), with skilled-labor shortages becoming significant enough to discourage inward investment. Wages have risen steadily, in part due to more aggressive union bargaining (48).

Czech tax revenues continue to rise. Total tax level in 2016 was at 34.6% as a proportion with GDP, which is the highest mark above the 2007 peak levels. Revenues from labor taxes have been increasing as a share of GDP in recent years, reaching 17.0 % in 2015, below the EU-28 average of 19.3 % of GDP. Tax intake in 2015 from property (0.6 % of GDP) and environmental taxes (2.1 % of GDP) continues to remain low in EU comparison (30).

Direct taxes, including the flat personal income tax, are low. By the second quarter of 2018 was 4386.7 billion CZK (84.7% of GDP, which is 9.7 billion less than in the second quarter of 2017. These numbers are very moderate by EU standards, with recent fiscal surpluses helping to push it further downward. A debt-limitation law was passed after years of controversy. R&D spending is rising quickly, approaching the EU average.

The Czech Republic is enjoying an economic upswing. The Czech economy is among the fastest growing in Europe. Real GDP have increased by 4 % in 2017 and is predicted to grow by around 3.4 % in 2018 and 3.1% in 2019, according to the Commission Winter 2018 forecast. This acceleration was due to strong export performance, especially for motor vehicles, and boosted by consumer confidence, increasing wages and low credit costs, private consumption growth remained high (30).

After falling in 2016, investment has bounced back in 2017, supported by the private sector and the renewed drawdown of EU funds. Earlier, economic policy in the Czech Republic mostly focused on balancing the budget and attracting incoming Foreign Direct Investment through low wages. Over time, as the limits to this strategy have increasingly become visible, the focus of the government shifted away from wage restraint and toward investment in education and R&D and the development of an environment for innovative activities within the domestic economy. However, in practice all these improvements are dependent on EU funding.

One of the most important changes in the economic policy framework has stemmed from the Czech National Bank's decision in April 2017 to end the commitment made in November 2013 to keep a low exchange rate of 27 CZK to the euro. The aim had been to counter the perceived threat of deflation by increasing import prices. Free to find its own level, the CZK floated upwards, holding back the level of inflation which rose slightly above the central bank's target level of 2% per annum in 2017. It is expected to rise up to 24.7 CZK to the euro in 2019 (48).

R&D spending in the Czech Republic has grown strongly under the new government and is expected to reach the EU's spending target of 2.5% in 2020. European structural funds have been the primary drivers of growth. Public R&D spending has suffered from a strong bias toward capital rather than current expenditure, meaning constructing research facilities rather than conducting research activities. Private R&D spending has also risen but remains dominated by foreign-owned enterprises, particularly in the automotive industry, which remain poorly integrated in the national innovation system (22).

## **1.7 Economic policy of Sweden**

Having fared well in both the crisis and post-crisis periods, Sweden shares high position in economic policies of European countries. The unemployment rate is 6.6% (aug2018) which is moderate by EU standards. The government has pledged to halve this by 2020, a task the recent influx of refugees will make more difficult. A policy of work incentives has been replaced by more government-sponsored employment as a means of providing labor-market access (27)

Sweden does not currently use the EUR as its currency and has no plans to replace the Swedish krona (SEK) in the near future. The government maintains that joining the ERM II (a requirement for euro adoption) is voluntary, and has chosen to remain outside pending public approval by a referendum. However, according to Matthijs Matthijs, The Eurozone will gradually take over the EU in institutional importance, which will have significant consequences for the 'euro-outs' like the UK, Sweden and Denmark. The outs may at some point face a painful choice between joining the euro and leaving the European Union altogether (12, p. 284).

The government has set modestly higher tax-rate and spending goals. As business taxes are today relatively low, competitiveness is not a pressing issue. Parliament set a revised budget-surplus goal of 0.33% in 2016, with a long-term commitment to public-debt reduction. The country invests strongly in R&D, though commercialization is a weak spot (48).

Sweden ranks among the top five advanced industrialized democracies on all aspects of research and development (R&D):

- spending (public and private) per capita;
- number of researchers;
- number of patent applications and intellectual ownership licenses.

This high level of investment in R&D has existed for considerable time. As an economy with high labour costs, Sweden's competitive edge lies not in large-scale manufacturing but in knowledge-intensive sectors. R&D spending thus directly sustains that competitive edge.

While R&D spending has a long history, converting research and development concepts into valuable products has been far more challenging for Sweden. The "Swedish paradox," as it is called, is precisely the inability to convert research findings into commercially viable products. However, as recent data show, Sweden now ranks first with regard to patent applications and license fees for intellectual property. This is a valid indicator that R&D is bearing fruit, as securing intellectual ownership of emerging products is a critical stage in the process from the research facility to the market. Public policy has targeted this very issue lately and the data suggest that R&D is now increasingly paying off (6, p.237).

## **1.8 Research and development**

In an effort to research and make discoveries that can help develop new products or way of doing things or work towards enhancing pre-existing products or processes, enterprises often spend resources on certain investigative undertakings. These activities come under the Research and Development (R&D) umbrella.

Research and Development is an important part for reaching future growth and keeping a relevant product in the market. There is a misconception that R&D is the area of high tech technology enterprises or the big pharmaceutical enterprises. In fact, most top-ranked consumer goods enterprises dedicate a substantial part of their resources towards developing new versions of products or improving existing designs. However, where most other enterprises may have less than 5 percent of their income on research, industries such as pharmaceutical, software or high technology products need to spend significantly given the nature of their products.

### **1.8.1 Types of R&D**

**Basic Research** category is when the main target of the research is to understand a subject matter more completely and build on the body of knowledge relating to it. No significant practical or commercial application follows. Main target of such type of research is to reveal the potential of the enterprise.

**Applied research** has more specific and directed objectives. Main goal of this type of research is to determine methods to address a specific customer/industry need or requirement, focusing on specific commercial objectives regarding products or processes.

**Development** starts when findings of a research are utilized for the production of specific products including materials, systems and methods. Development and design of prototypes and processes are also part of this area. A vital discrepancy at this point is between development and engineering or manufacturing. Development is research that generates requisite knowledge and designs for production and converts these into prototypes. Engineering is utilization of these plans and research to produce commercial products.

### **1.8.2 Advantages of R&D**

Though setting up an R&D function is not an easy task by any means, it has its unique advantages for the organization. These include the following.

**Tax breaks.** Research and Development expenses are often tax deductible. This depends on the country of operations of course but a significant write-off can be a great way to offset large initial investments. But it is important to understand what kinds of research activities are deductible and which ones are not. Generally, things like market research or an assessment of historical information are not deductible.

**Costs.** An enterprise can use research to identify leaner and more cost effective means of manufacturing. This reduction in cost can either help provide a more reasonably priced product to the customer or increase the profit margin.

**Financing.** When an investor sets out to put their resources into any enterprise, they tend to prefer those who can become market leaders and innovate constantly. An effective R&D function goes a long way in helping to achieve these objectives for an enterprise. Investors see this as a proactive approach to business and they may end up financing the costs associated with maintaining this R&D function.

**Recruitment.** Top talent is also attracted to innovative enterprises doing exciting things. With a successful Research and Development function, qualified candidates will be excited to join the enterprise.

**Patents.** Through R&D based developments, enterprises can acquire patents for their products. These can help them gain market advantage and cement their position in the industry. This one time product development can lead to long term profits.

### 1.8.3 R&D Challenges

R&D also has many challenges associated with it. These may include the following.

**High Costs.** Initial setup costs as well as continued investment are necessary to keep research work cutting edge and relevant. Not all enterprises may find it feasible to continue this expenditure.

**Increased Timescales.** Once a commitment to R&D is made, it may take many years for the actual product to reach the market and a number of years will be filled with no return on continued heavy investment.

**Uncertain Results.** Not all research that is undertaken yields results. Many ideas and solutions are scrapped midway and work has to start from the beginning.

**Market Conditions.** There is always the danger that a significant new invention or innovation will render years of research obsolete and create setbacks in the industry with competitors becoming front runners for the customer's business.

It is important for any business to understand the advantages and disadvantages of engaging in Research and Development activities. Once these are studied, then the step can be taken towards becoming an R&D organization.

In the meanwhile, it is good practice to inculcate a research mind set and research oriented thinking within all employees, no matter what their functional area of expertise. This will help bring about new ideas, new solutions and an innovative way of approaching all business problems, whether small or large.

## **1.9 Automotive industry**

Automotive industry belongs to one of the most important industries in Europe due to high demand for motor vehicles. The turnover generated by the automotive sector represents 6.8% of EU GDP. The automobile industry has ripple effects throughout the economy, supporting a vast supply chain and generating an array of business services.

Almost all of public services, such as emergency, police, post, public transport etc. - are delivered by cars, trucks and vans.

The European auto industry is a global player, delivering quality 'Made in Europe' products around the world, and bringing in a €90.3 billion trade surplus (29).

### **1.9.1 Definition of the automotive industry.**

The automotive industry belongs to secondary sector of economics and consists of a wide range of enterprises and organizations involved in the design, development, manufacturing, marketing, and selling of motor vehicles. This industry refers to one of the world's largest economic sectors by revenue. It does not include industries dedicated

to the maintenance of automobiles following delivery to the end-user, such as automobile repair shops and motor fuel filling stations.

**Automotive products:**

- Cars
- Trucks
- Buses
- Motorcycle

**1.9.2 Electric cars**

An electric car is a car that is driven not by an internal combustion engine, but by one or more electric motors powered by batteries or fuel cells. Oddly enough, but the electric car appeared before its gasoline counterpart. The first electric car, created in 1841, was a trolley with an electric motor. Due to the insufficiently improved system of charging the electric motor, petrol cars won the unofficial fight for dominance in the automotive market. Only in the 1960s, interest in electric vehicles began to appear again. The reason for this was the environmental problems of vehicles and the energy crisis, which provoked a sharp increase in the cost of fuel (52).

The electric car has a number of undeniable advantages: the absence of exhaust gases that are harmful to the environment and living organisms, low operating costs (because electricity is much cheaper than automotive fuel), high efficiency of the electric motor (90-95%, and efficiency of a gasoline engine only 22-42 %), high reliability and durability, simplicity of design, the possibility of recharging from a conventional outlet, low risk of explosion during an accident, high smoothness. But there are not only advantages but also negative advantages. Among them the imperfection of batteries, they either operate at too high temperatures (more than 300 ° C), or are too expensive due to the presence of expensive metals. Moreover, these batteries have a high degree of self-discharge and their charging takes a very long time compared to charging with fuel. In addition, the problem is the disposal of batteries, which contain various toxic components and acids, the lack of an appropriate infrastructure for charging batteries,

the possibility of overloading in electrical networks at the time of mass recharging from a household network, which can adversely affect the quality of power supply.

The main reason that hinders mass production of electric vehicles is insufficient demand due to the high cost of an electric vehicle and a small mileage from one recharge. The high price is due to the high cost of batteries and their shortage; so many automakers have established joint production with the enterprises that produce batteries. Such subtypes of electric vehicles as a truck and electric lift truck are widely used at railway stations, in large stores and workshops, i.e. where freight is required. This type of transport is very practical to use for such purposes, since the absence of emissions and noise are fundamental points for servicing closed public areas.

Many enterprises are developing batteries with a short charging time, using nanomaterials and the latest technology. Every self-respecting car concern considers it its duty to manufacture and launch a car that runs on electricity. The production of electric vehicles at this time is a priority for the development of the global automotive industry.

## 2. Analysis of the current state

### 2.1 GDP per capita

The table below shows GDP per capita in EUR 2009-2018

**Table 4: GDP per capita 2009-2018** (Source: 33).

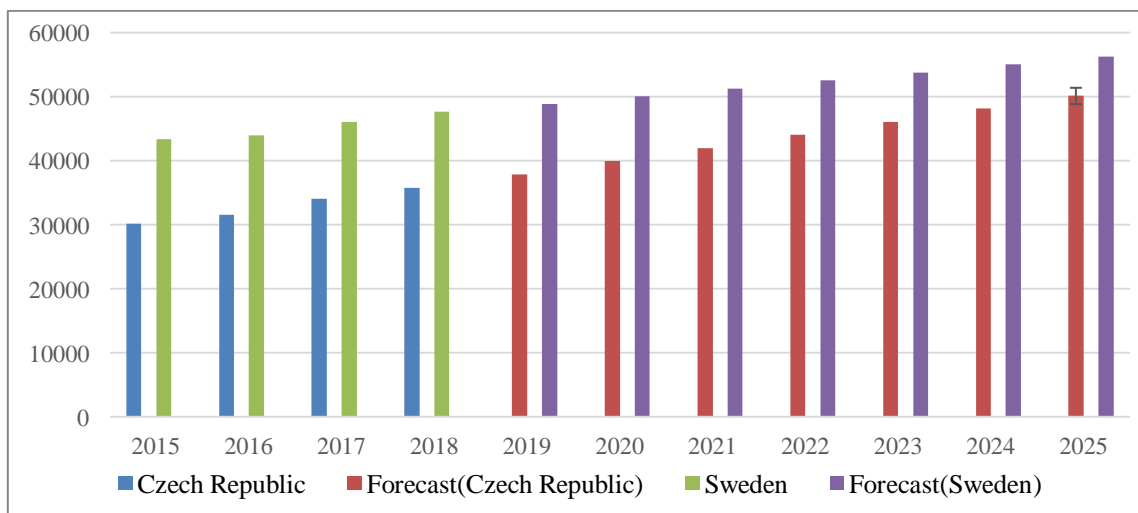
Country	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Czech Republic</b>	24611	24683	25795	26023	27318	28902	30189	31562	34073	35795
<b>Sweden</b>	35558	37294	39243	40108	40957	41719	43389	43968	46048	47629
<b>OECD</b>	30448	31606	32850	33727	34942	35977	37025	38015	39644	41230

As can be seen from the table Sweden has much higher GDP per capita not only comparing with Czech Republic but also comparing with average OECD countries rate.

Czech Republic in 2018 reached relatively same GDP rate as Sweden had in 2009.

**Table 5 Forecast GDP per capita 2015-2025** (Source: on base of 33)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
<b>Czech Republic</b>	30189	31562	34073	35795	37891	39936	41980	44025	46070	48115	50160
<b>Sweden</b>	43389	43968	46048	47629	48825	50063	51301	52539	53778	55016	56254



**Figure 3: Forecast GDP per capita 2015-2025** (Source: on base of 33).

With the help of Excel statistical methods, I have forecasted possible GDP index in years 2019-2025. As can be seen from the Table 35 and Figure 3, Czech Republic is going to reach 2018 Sweden's GDP per capita in between 2023 and 2024 years.

## **2.2 Energy intensity**

Addressing energy supply issues, improving the energy efficiency of national economies are the most important tasks for the Czech Republic and for the overwhelming majority of countries around the world, the solution of which ensures the political sovereignty of the state and its economic efficiency. The cyclicity of the world economy causes the appearance of crisis phenomena that affect the growth of prices for most energy resources, and given the non-renewability of oil and natural gas, the complexity and cost of production may exhaust their reserves in the coming decades. According to the forecasts of the International Energy Agency, the aggregate demand for primary energy in the world will increase by an average of 1.4% per year (35).

The national economy has traditionally been based on fossil fuels - coal, which represents about 60% of all energy sources. The open form of coal mining has a very unfavorable effect on nature, therefore the production volume is gradually decreasing. Brown coal is mainly used in the production of electrical energy. The production of electricity in the Czech Republic is provided primarily by thermal power stations, which are located near coal deposits. These power plants produce 45% of the total electricity generation (Figure 4). The next significant source of electricity is the two nuclear power stations, in Temelin in South Bohemia and in Dukovany in South Moravia. As can be seen from Figure 4, the main share in electricity generation is occupied by coal and nuclear power. In turn, in Sweden (Figure 5), renewable energy sources dominate: nuclear and hydroelectric stations.

Energy intensity level of primary energy (MJ/\$2011 PPP GDP) in Sweden was reported at 4.2691 in 2015, according to the World Bank collection of development indicators, compiled from officially recognized sources.

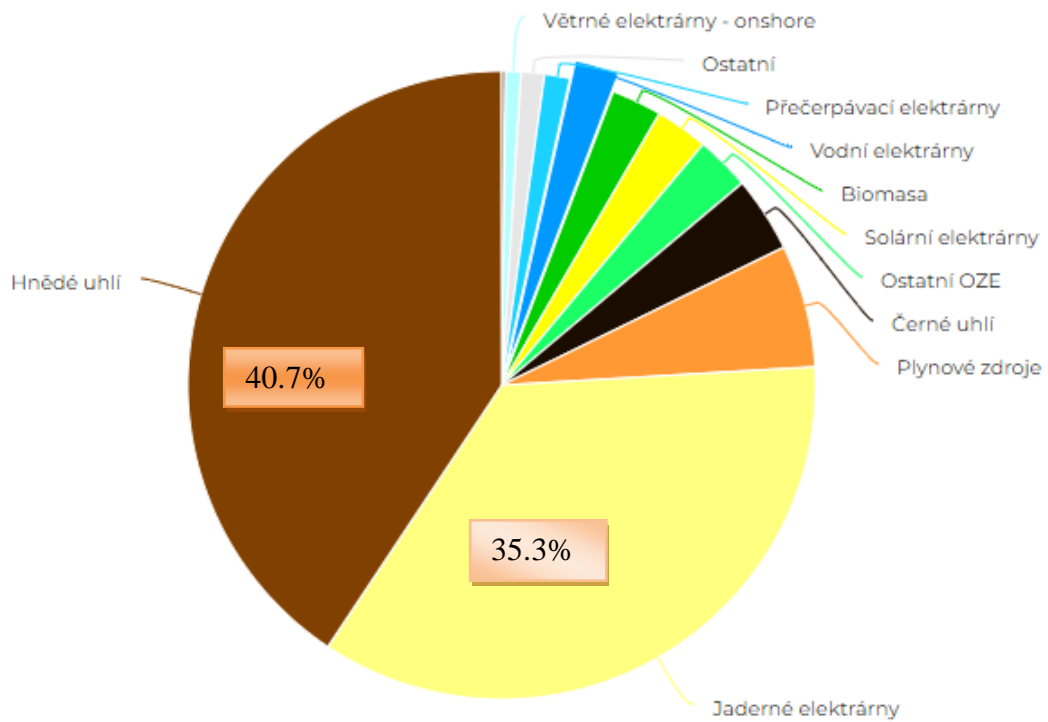


Figure 4: Share of electricity generation resources in Czech Republic, 2018 (Source: 38).

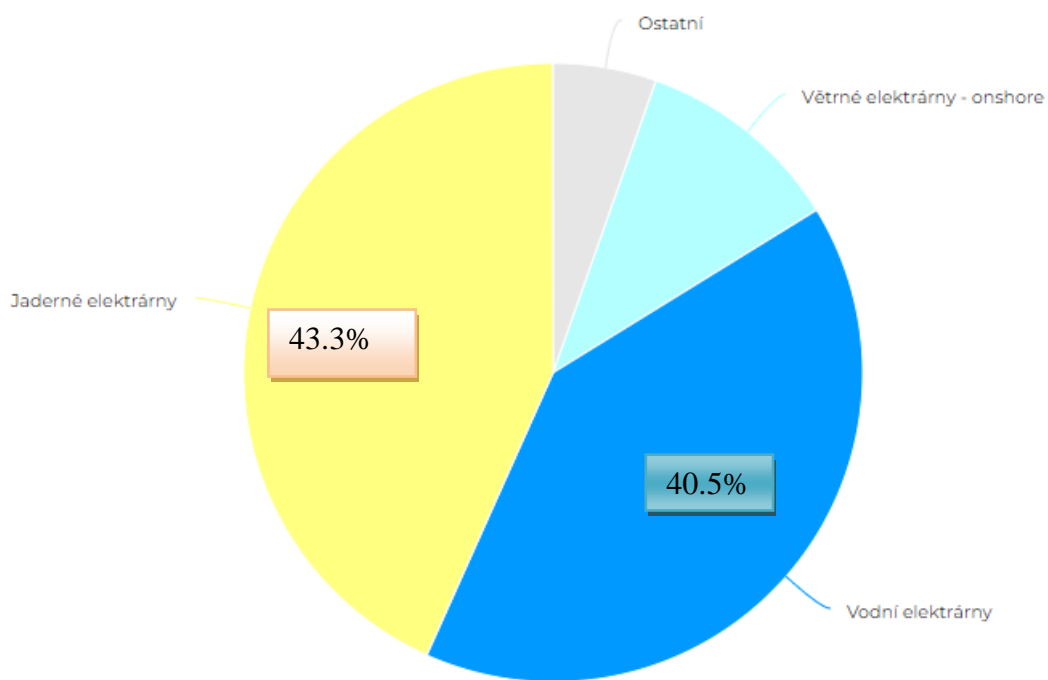


Figure 5 Share of electricity generation resources in Sweden, 2018 (Source: 38).

In the 2015 the Czech Republic approved a new State Energy Policy (SEP). The main purpose of the State Energy Policy (SEP) is to ensure reliable, secure and environmentally-friendly supplies of energy to meet the needs of the populace and economy of the Czech Republic, at competitive and acceptable prices under standard conditions. It must also secure uninterrupted energy supplies in crisis situations to the extent necessary to ensure the functioning of the main components of the state and the survival of the population. The review warns that reaching long-term energy targets will require greater effort if the country is to play its part in the on-going global energy transition.

The new SEP seeks ways to strengthen security of energy supply and build a competitive and sustainable energy sector. In recent years the Czech Republic has experienced strong growth in the renewable energy sector – notably solar PV. Meanwhile, greenhouse gas emissions, which have been falling since 2000, are expected to increase. Coal dominates the power sector and is the largest source of carbon emissions and also poses a substantial threat to local air quality.

For now natural gas supply security remains strong, and the country is expected to remain a net exporter of electricity. The expansion of nuclear power is one of the main pillars of the SEP, and will play a greater role in coming years.

### 2.3 Population of the Czech Republic and Sweden

The table below represents latest available population data in Sweden and Czech Republic (in thousands). As we can see countries have relatively equal population. This indicator was one of the reasons I have chosen these two countries for comparison.

**Table 6: Population of the Czech Republic and Sweden** (Source: 24).

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<b>Czech Republic</b>	10.20	10.21	10.23	10.27	10.32	10.43	10.49	10.52	10.50	10.51	10.51
<b>Sweden</b>	8.96	8.99	9.03	9.08	9.15	9.22	9.30	9.38	9.45	9.52	9.61

### 2.3.1 Total employment

The table shows total employment in the Czech Republic and Sweden without division into different industries (in thousands) (51).

**Table 7: Employment in the Czech Republic and Sweden** (Source: 51).

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Czech Republic</b>	4930	4890	4870	4890	4940	4970	5040	5140	5220	5270	5230
<b>Sweden</b>	4540	4593	4498	4523	4625	4657	4704	4772	4837	4910	5022

The next table compares unemployment rates of Czech Republic and Sweden.

**Table 8: Unemployment rate in the Czech Republic and Sweden** (Source: 51).

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Czech Republic</b>	5.32	4.39	6.66	7.28	6.71	6.98	6.95	6.1	5.05	3.95	2.89
<b>Sweden</b>	6.12	6.18	8.3	8.58	7.77	7.96	8.01	7.92	7.4	6.99	6.72

As we can see from Tables 7 and 8, total number of employments in Czech Republic and Sweden is compatibly same, however Czech Republic has much lower unemployment level than in Sweden, reaching a difference of 3.83%.

### 2.3.2 Employment in the automotive industry

The table shows average number of employees in automotive industry in Czech Republic and Sweden (in thousands).

**Table 9: Average number of employees in the Automotive Industry** (Source: 25, 26).

Country	2010	2011	2012	2013	2014	2015	2016	2017
<b>Czech Republic</b>	138,3	145,2	141,9	139,6	145,4	155,8	164,8	173,1
<b>Sweden</b>	77,2	79,1	76,9	76,2	76,1	79,9	83,3	87,8

As can be seen from the table, the volume of people employed in the automotive industry grows from year to year excluding year 2011-2012. This was caused mainly by economic crisis 2011-2012, which led to a decrease in production and, consequently, decrease in employment. This is also can be seen in Table 4 from previous sub chapter.

## **2.4 Automotive industry**

### **2.4.1 Automotive industry in the Czech Republic**

The Czech automotive industry employs more than 150,000 people and accounts for more than 20% of both Czech manufacturing output and Czech exports. According to ACEA Czech Republic has the 5<sup>th</sup> biggest car production in the EU (29). The Czech automotive center of excellence plays a key role not only in the European but also in the global perspective. Based on the country's century-long engineering tradition, good infrastructure and skilled workforce, it significantly contributes to automotive manufacturing and R&D. While the country has the capacity and resources to accommodate three major carmakers – Škoda Auto (Volkswagen group), TPCA (Toyota/Group PSA joint venture) and Hyundai Motor Manufacturing Czech – and holds excellent business opportunities for suppliers, the Czech Republic is poised to consolidate its position as one of the leading European centers for automotive-related design and R&D activity (46).

The Table 10 represents passenger car production in the Czech Republic in years 2007-2017 and its' annual change.

**Table 10 : Passenger car production in Czech Republic (Source: 29).**

Year	Amount	Annual change (%)
2007	880 083	7.15%
2008	831 798	-5.49%
2009	913 147	9.78%
2010	1 017 331	11.41%
2011	1 090 046	7.15%
2012	1 046 575	3.99%
2013	1 033 802	-1.22%
2014	1 131 247	9.43%
2015	1 225 862	8.36%
2016	1 344 182	9.65%
2017	1 413 881	5.19%

#### **2.4.2 Automotive industry in Sweden**

Automotive industry of Sweden relates to one of the most innovative and dynamic in the world. Swedish automotive ecosystem attracts enterprises from worldwide eager to work with or alongside national champions like Volvo and Scania.

Sweden's wide vehicle manufacturing heritage offers a winning environment for automotive operations – from production, software development, safety systems, components supply, testing up to R&D. As technology upgrades vehicles and the way they are produced, manufacturers are seeing the potential of localizing production to regions with highly skilled labor and expertise in mobile communications systems, connectivity and automation.

As an international tech leader, Sweden is a strategic location for developers of ICT-based automotive applications and research leaders who are developing the transport solutions of tomorrow. It is also a preferred destination for auto testing thanks to state-of-the-art testing facilities for vehicles and components in all climates and conditions – from sub-zero Arctic Lapland to simulated desert heat (19).

Developers and manufacturers looking for ways to create new or optimize existing automotive materials and technologies, can find lots of opportunities in Sweden. They

can partner with leading experts and tap into Swedish strengths in auto safety, autonomous cars and vehicle connectivity, connect with knowledge-driven product developers or to cooperate with one of Sweden’s numerous niche and high-tech suppliers.

For now in Sweden already exist collaboration programs with such international enterprises as Chinese automaker Geely, which has built a bespoke development and design center, and Bosch, which has created an automotive software facility.

Sweden is currently heading towards its target of a zero-carbon vehicle fleet by 2030. The country is thus a natural choice for green vehicle development (48).

The Table 11 represents passenger car production in Sweden in years 2007-2017 and its’ annual change.

**Table 11: Passenger car production in Sweden** (Source: 29).

Year	Amount	Annual Change
2007	316 848	9.71%
2008	253 272	-20.07%
2009	129 635	-48.82%
2010	177 498	36.92%
2011	190 090	7.09%
2012	163 482	-14.00%
2013	163 573	0.06%
2014	154 913	-5.29%
2015	189 881	22.57%
2016	205 374	8.16%
2017	254 079	23.72%

### **2.4.3 Automotive industry enterprises 2012-2016**

The next tables show the number of enterprises involved in the automotive industry of the Czech Republic and Sweden (in thousands) as well as their operational revenue.

**Table 12: The number of enterprises involved in the automotive industry (Source: 18).**

Country	2012	2013	2014	2015	2016
<b>Czech Republic</b>	479	512	537	552	678
<b>Sweden</b>	558	577	601	614	733

**Table 13: Operating revenue in the automotive industry (th.EUR) (Source: 18).**

Country	2012	2013	2014	2015	2016
<b>Czech Republic</b>	32 729 628	32 010 881	37 679 258	42 987 890	46 271 077
<b>Sweden</b>	36 093 460	35 907 393	34 952 791	41 866 962	44 305 854

As can be seen from Table 12 and Table 13, even if the Czech Republic has 12.5% less enterprises engaged in the automotive industry, Czech industry has even higher revenues than Swedish industry (4.4%).

#### **2.4.4 The territorial allocation of enterprises in the regions of Sweden**

The automotive industry is omnipresent in Sweden. There are groups of enterprises in almost any city. Västra Götaland and Stockholm have the two largest clusters of automotive businesses, followed by the Jönköping region. The latter region is packed with small enterprises (18).

The Table 14 shows the 5 enterprises with the highest operational revenue in the automotive industry in Sweden in 2016.

These 5 enterprises held 93.67% of the total operational revenue in the Swedish automotive industry in 2016. It should also be noted that 4 out of 5 of these enterprises belong to one big corporation – the Volvo group.

**Table 14: Top 5 enterprises in the Automotive industry of Sweden (Source: 18).**

Enterprise	Operational revenue(th. EUR)	% of total operational revenue in Sweden
<b>VOLVO PERSONVAGNER AKTIEBOLAG</b>	15 948 839	35.99
<b>SCANIA CV AKTIEBOLAG</b>	12 290 617	27.74
<b>VOLVO LASTVAGNAR AKTIEBOLAG</b>	10 149 362	22.9
<b>VOLVO POWERTRAIN AKTIEBOLAG</b>	2 120 082	4.78
<b>VOLVO BUSSAR AKTIEBOLAG</b>	1 002 668	2.26

**The Volvo Group** (Swedish: Volvokoncernen; legally Aktiebolaget Volvo, shortened to AB Volvo) (stylized as VOLVO) is a Swedish multinational manufacturing company founded in 1927, headquartered in Gothenburg. While its core activity is the production, distribution and sale of trucks, buses and construction equipment, Volvo also supplies marine and industrial drive systems and financial services. In 2016, it was the world's second largest manufacturer of heavy-duty trucks.

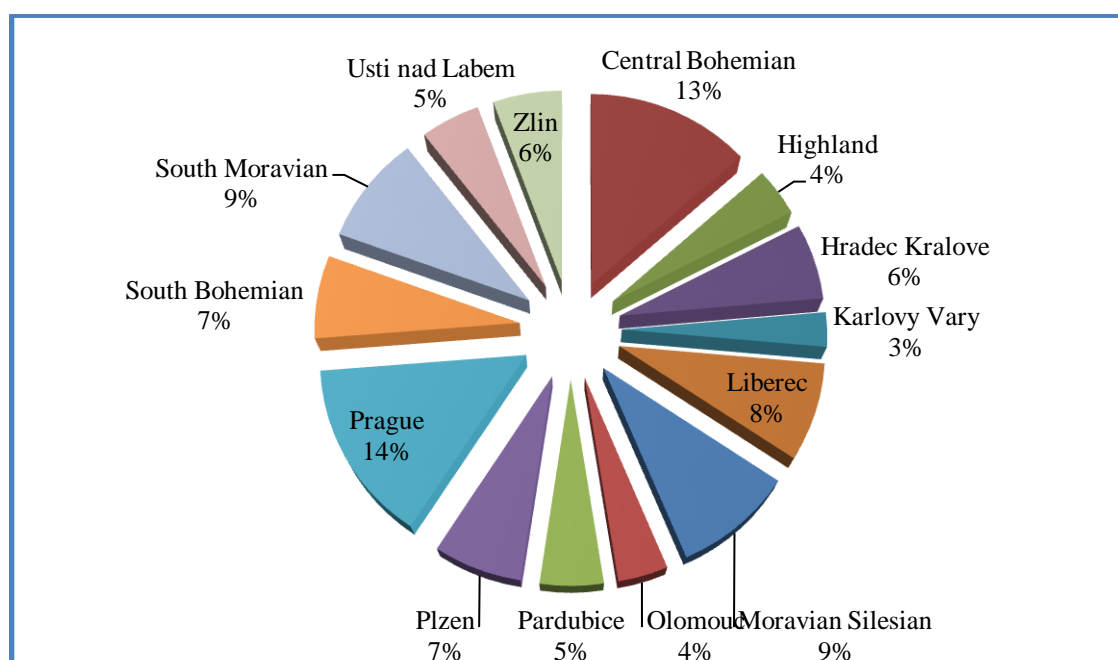
**Scania AB** is a major Swedish manufacturer of commercial vehicles – specifically heavy trucks and buses, formed in 1911 through the merger of Södertälje-based Vabis and Malmö-based Maskinfabriks-aktiebolaget Scania. It also manufactures diesel engines for heavy vehicles as well as marine and general industrial applications.

#### **2.4.5 The territorial allocation of enterprises in the regions of the Czech Republic**

Table and figure below show the allocation of enterprises by number of enterprises in the regions of the Czech Republic. It is clear why the largest number of enterprises is located in Prague (14%) and Central Bohemian region (13%) as Prague is the capital of the Czech Republic. It is historically proved that the largest amount of enterprises is always located nearby the capital of the country. Main reason is that capital is an economical, business, distributional centre of the country.

**Table 15: Allocation of enterprises by Czech Republic regions (Source: 18).**

Region	Number of enterprises	Operation revenue (in mil) Year 2016
Central Bohemian	91	19672
Highland	27	1400
Hradec Kralove	42	578
Karlovy Vary	19	104
Liberec	54	3064
Moravian Silesian	63	11149
Olomouc	26	367
Pardubice	33	1377
Plzen	46	2753
Prague	99	345
South Bohemian	46	2705
South Moravian	61	840
Usti nad Labem	33	1555
Zlin	38	360



**Figure 6: Allocation of enterprises by number of enterprises (Source: 18).**

The Figure 7 presents the allocation of enterprises in different regions of the Czech Republic in terms of their operational revenue. As we can see, the results of the figure 6 are very different from the previous one. There are a large number of enterprises in the

capital; however their percentage in total operational revenue is extremely low (1%). This is due to the fact that the largest enterprises are not located in the capital but in Central Bohemian region.

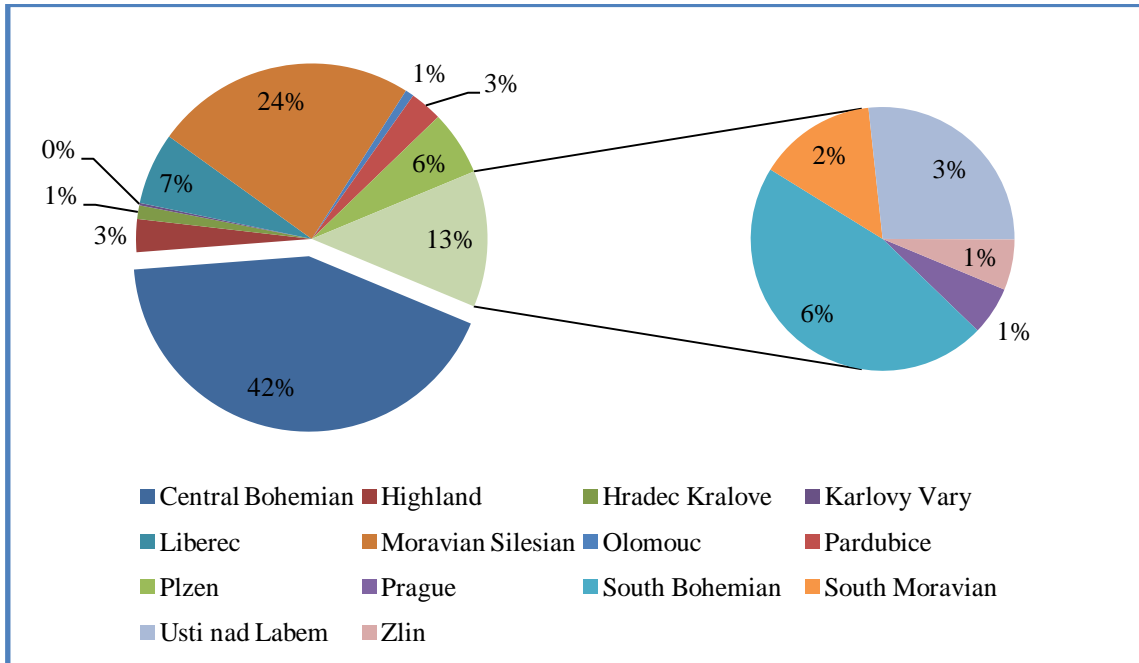


Figure 7: Allocation of enterprises by operational revenue (Source: 18).

The Table 16 shows the 5 enterprises with the highest operational revenue in the automotive industry in the Czech Republic in 2016. These 5 enterprises held 56.22% of the total operational revenue in the Czech automotive industry in 2016.

Table 16: Top 5 enterprises in the automotive industry of CR (Source: 18).

Enterprise	Operational revenue (th.)	% of total operational revenue in CR
<b>ŠKODA AUTO, A.S.</b>	16 479 685	35.61
<b>HYUNDAI MOTOR MANUFACTURING CZECH, S.R. O.</b>	5 561 966	12.02
<b>TOYOTA PEUGEOT CITROËN AUTOMOBILE CZECH, S.R.O.</b>	1 435 756	3.10
<b>MOBIS AUTOMOTIVE CZECH, S.R.O.</b>	1 362 886	2.95
<b>IVECO CZECH REPUBLIC, A. S.</b>	1 174 602	2.54

**Skoda Auto, a.s.** is the biggest Czech automobile manufacturer founded in 1985. Main production is located in Mlada Boleslav (Central Bohemian region). Two more production branches are in Kvasiny (Hradec Kralove region) and Vrchlabi (Hradec Kralove region) towns. Skoda Auto also owns its own private University – Skoda Auto University in Mlada Boleslav. In 2016 Skoda Auto produced 1,126,477 vehicles. Enterprise continues growing and produced 1,253,741 vehicles in year 2018. By the end of 2022, it plans to bring out more than 30 new models, ten of which will be partially or fully electric. 2019 is the year that Skoda launches plans to launch 1<sup>st</sup> electro car.

**Hyundai Motor Manufacturing Czech** Enterprise based in the Industrial Zone of Nošovice was founded on 7th July 2006. An agreement on the highest foreign investment in the history of the Czech Republic was concluded by representatives of the Czech Republic, Moravian-Silesian region, CzechInvest agency and Hyundai Motor Group in Korea one year earlier. Enterprise produces up to 350,000 vehicles per year. For now Hyundai Motor Manufacturing Czech Enterprise produces only four types of vehicles. Currently no official information about the production of electric cars provided.

**Toyota Peugeot Citroën Automobile Czech s.r.o. (TPCA)** is an automobile manufacturing enterprise in Kolín(Central Bohemian region), Czech Republic. It is a joint venture between Toyota Motor Corporation and Groupe PSA (previously PSA Peugeot Citroën). It manufactures Toyota, Peugeot and Citroën models in the Czech Republic for sale in Europe. TPCA produces small cars mainly for the European market. In the year 2017 TPCA produced 200,000 vehicles.

The enterprise **Mobis Automotive Czech Ltd.**, which was founded on December 12, 2006 is located in the industrial zone in Nošovice (Moravian Silesian region). Mobis Automotive produces no vehicles but modules (front and rear axle and cockpit) and on other core parts such as airbag and brake systems.

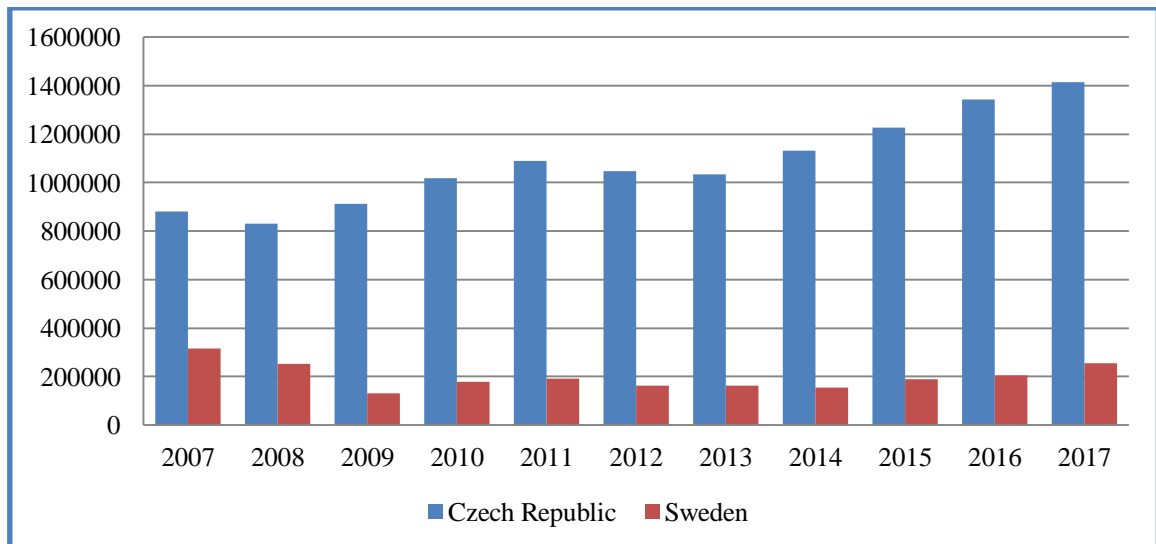
**Iveco Czech Republic, a.s.** is a Czech manufacturer producing buses founded in 1978 by merging five enterprises with over 150 years of experience in designing and manufacturing industrial vehicles such as Magirus-Deutz, Fiat, Lancia, Unic and OM. In the year 2013 produced 3165 buses. Iveco is the Europe's largest bus factory.

## 2.5 Comparison of passenger car production in the Czech Republic and Sweden

The table compares the level of passenger car production of Czech Republic and Sweden in years 2007-2017 (29). Data given in thousands.

**Table 17. Comparison of passenger car production in Czech Republic and Sweden** (Source: 29).

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Czech Republic</b>	880	831	913	1017	1090	1046	1033	1131	1225	1344	1413
<b>Sweden</b>	316	253	129	177	190	163	163	154	189	205	254
<b>European Union</b>	16620	15318	13451	14709	15006	14176	14227	14952	16030	16925	16957



**Figure 8: Passenger car production in Czech Republic and Sweden** (Source: 29).

As can be seen from the Table 17 and the Figure 8, in 2008 there was quite high fall in car production both in the Czech Republic and in Sweden. This situation was caused by economic crisis in the years 2007-2008.

We can see one more decrease of production in year 2012 due to consequences of 2008 crisis.

**Table 18: The percentage of cars produced in the Czech Republic and Sweden, compared with the whole EU (Source: 29).**

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Czech Republic</b>	5.29	5.42	6.79	6.91	7.26	7.38	7.26	7.56	7.64	7.94	8.33
<b>Sweden</b>	1.90	1.65	0.96	1.20	1.27	1.15	1.15	1.03	1.18	1.21	1.52
<b>European Union</b>	100	100	100	100	100	100	100	100	100	100	100

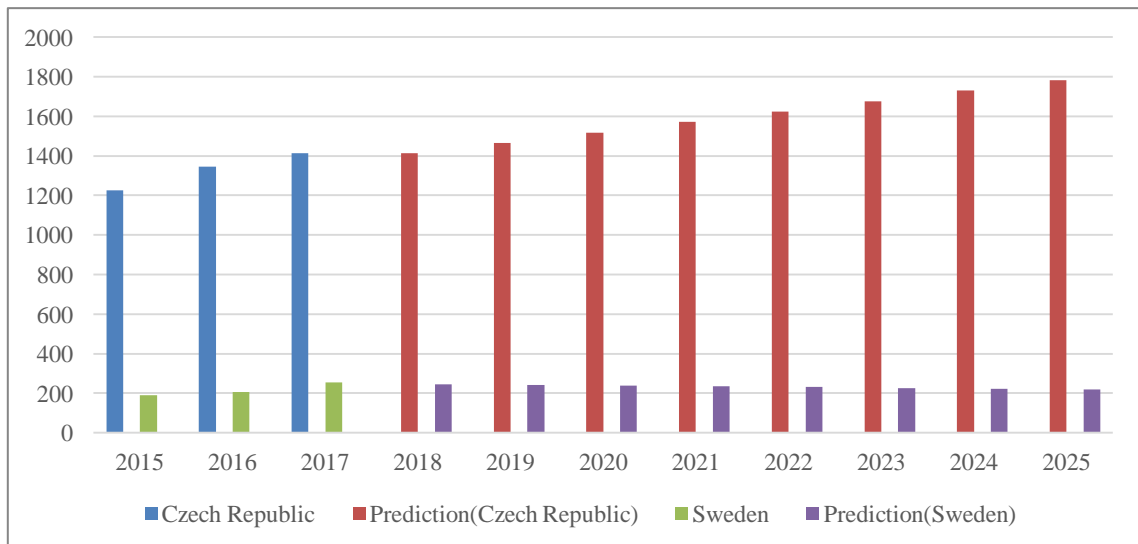
Table 18 shows the percentage of cars produced in the Czech Republic and Sweden, compared with the total car production in the EU in years 2007-2017. The Czech Republic increases its production from year to year (excluding 2013). It can be noted that despite the overall decrease in the number of cars produced in the Czech Republic in 2007-2008 by 5.56% (from 880 in 2007 to 831 in 2008), the market share occupied by the Czech Republic in the European Union increased by 0.13% within the same period. On the contrary, the market share occupied by Sweden in the European Union decreased by 0.25% within the same period.

Despite of crisis in the Czech Republic was able not only retain the production volume but also increase it by 60% in 2017 compared to 2007. Sweden, on the contrary, was unable to maintain production volume and reduced products by 20% in 2017 compared with 2007.

The table and figure below shows prediction of car production in the Czech Republic and Sweden until 2025 year deducted using Excel statistical methods. Data in thousands.

**Table 19 Prediction of car production 2015-2025 (Source: on base of 29).**

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
<b>Czech Republic</b>	1225	1344	1413	1412.9	1465.7	1518.4	1571.2	1623.9	1676.7	1729.4	1782.2
<b>Sweden</b>	189	205	254	244.87	241.25	237.62	234.00	230.37	226.75	223.12	219.50



**Figure 9: Prediction of car production 2015-2025** (Source: on base of 29).

It is quite obvious that the industrial production, especially in the automotive industry, still has ways of improvements and growth and has not yet reached its peak.

## 2.6 Investment climate in the Czech Republic in 2018

The Czech Republic is guided by EU law and Organization of Economic Cooperation and Development standards for the equal treatment of foreign and domestic investors. Labor laws are quite comparable with those of most developed nations. Wages are the highest comparing to Western European countries and are rising about five percent yearly due to the economy having reached nearly full employment (50).

Since the fall of communism great moves were taken to open the market to competition and privatization, but the prosecution of anti-trust violations is still less than adequate. Corruption remains a problem. Czech Intellectual Property Rights protections are still not optimal, but the legal framework for IPR protection has been tested and proven successful in punishing infringers. Other western concepts such as entrepreneurship and corporate social responsibility are growing trends in the Czech business and non-governmental communities.

There are no general restrictions on foreign investment, although limits exist within certain sectors. The Czech Republic takes steps to diversify its traditional investments in engineering into new fields of research, development and innovative technology. Structural funding of the EU has enabled the country to open a number of world-class

scientific and high-tech centers. Most of the foreign investors are from EU countries, but the Czech government is seeking ways to expand export zones and investment opportunities from non-European regions, including the United States, China, and South Korea (36).

From 2012 any of the non-EU nationals can purchase real property, including agricultural land, in the Czech Republic without restrictions. Enterprises, which are legally registered in the Czech Republic, including 100 percent foreign-owned subsidiaries, may own real estate without any limitations. The right of foreign and domestic private entities to establish and own business enterprises is guaranteed by law in the Czech Republic. Enterprises are permitted to engage in any legal activity with the limitations in some sensitive sectors. Laws on auditing, accounting and bankruptcy are in force. These laws include the use of international accounting standards for consolidated corporate groups (50).

Table below shows main investment indexes in the Czech Republic.

**Table 20 Main investment indexes in the Czech Republic** (Source: 50).

Measure	Year	Index/Rank
TI Corruption Perceptions Index	2016	47 of 175
World Bank’s Doing Business Report “Ease of Doing Business”	2017	27 of 190
Global Innovation Index	2016	27 of 128
U.S. FDI in partner country (\$M USD, stock positions)	2015	5,831
World Bank GNI per capita	2015	10,547

### **Financial Support for Investment**

The Czech Republic offers both new and existing investors support covering up to 25% of costs associated with investment projects through several schemes. Aid is provided mainly from the national investment-incentives scheme described in Act No.72/2000 on Investment Incentives.

Certain activities, for example establishment of R&D centers, innovation activities and ICT and software development, can be also supported from EU Structural Funds.

Investment Incentives Supported areas Investment incentives are offered for establishment or expansion of projects in the areas of:

- Manufacturing
- R&D and technology centers
- Centers of business support services
- shared-services, high-tech repair and software development centers

Aid is provided in all regions, with the exception of Prague, pursuant to the Act on Investment Incentives and consists of the following incentives (36):

- **Tax incentive** Full corporate tax relief for up to ten years for new enterprises. Partial corporate tax relief for up to ten years for existing enterprises
- **Job-creation grants** Financial support for creation of new jobs in selected regions (EUR 7,400 per new job).
- **Training and retraining grants.** Financial support for training and retraining of new employees in selected regions (25% of eligible training costs for large enterprises).
- **Cash grants for capital investments** Financial support available for large strategic investment projects in the areas of manufacturing and technology centers only (up to 5% of the investment amount); subject to special eligibility criteria.

## 2.7 Investment climate in Sweden in 2018

Sweden belongs to one of the highly-favorable investment destination. It offers an extremely competitive, open economy with access to new products, technologies, skills, and innovations. Sweden also has a stable political environment, which makes it a good investment destination for enterprises. Among this Sweden also offers low levels of corporate tax and the absence of tax on dividends (48).

According to Bloomberg's 2018 Innovation Index, Sweden, along with South Korea, is ranked as the most innovative nation on earth Sweden. Sweden is seen as a frontrunner in adopting new technologies and setting new consumer trends (44).

Sweden’s attractiveness as an investment destination is affected by a few structural, business challenges. Among them are high personal and VAT tax regimes, the high cost of labor, rigid labor legislation and regulations, a persistent housing shortage, and the general high cost of living. These aspects can present challenges to attracting, hiring, and maintaining talent for new enterprises entering Sweden (51).

Table below shows main investment indexes in Sweden.

**Table 21 Main investment indexes in Sweden** (Source: 51).

Measure	Year	Index/Rank
TI Corruption Perceptions Index	2017	6 of 175
World Bank’s Doing Business Report “Ease of Doing Business”	2017	10 of 190
Global Innovation Index	2017	2 of 128
U.S. FDI in Partner Country (M USD, stock positions)	2015	USD 46,933
World Bank GNI per capita	2015	USD 54,480

## **2.8 Gross domestic Research and Development expenditure**

According to the Europe-2020 targets, expenditures in each EU country for Research and Development should reach 3% of EU GDP.

Table in this section compares R&D expenditure costs in Czech Republic, Sweden, European Union and average value of all data available to the OECD. Data from 2018 are not available yet. The data in the table are given as percentage of GDP per year.

The highest expenditure level is held by Sweden, it is also one of the highest indicator within all of the countries (between 3<sup>rd</sup> and 4<sup>th</sup> in different years). 1<sup>st</sup> place in R&D expenditure belongs to South Korea – 4,553% in 2017 (40). We can also notice that level of expenditures is almost twice as high as in the EU counties and one and a half times higher than the average level.

On the other hand Czech Republic is below average level of R&D expenditure and was 2.49 times less that Sweden expenditure in 2017.

**Table 22: Gross domestic R&D expenditure** (Source: 40).

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Czech Republic</b>	1.302	1.239	1.294	1.337	1.556	1.782	1.900	1.973	1.929	1.680	1.791
<b>Sweden</b>	3.253	3.491	3.446	3.213	3.245	3.278	3.303	3.143	3.264	3.301	3.327
<b>EU countries</b>	1.690	1.756	1.833	1.834	1.875	1.911	1.920	1.956	1.957	1.960	1.963
<b>OECD Total</b>	2.204	2.273	2.320	2.282	2.313	2.308	2.330	2.352	2.344	2.342	2.368

## 2.9 Research and development in Sweden

As can be seen from the Table 23, in 2017, intramural R&D expenditure in Sweden amounted to SEK 155.5 billion (EUR 14.62 billion) in total. This is an increase of SEK 13 billion (EUR 1.22 billion), which corresponds to 8 percent, from 2016, in 2017 prices. Over the past ten years, total R&D expenditure has increased almost each survey year, although there have been variations in individual sectors between the years. The business enterprise sector was the sector that increased the most since the 2015 survey. Intramural R&D expenditure in the business enterprise sector increased by SEK 11.8 billion (EUR 1.103 billion) in fixed prices between 2015 and 2017.

**Table 23: R&D expenditures 2007-2017** (Source: 33).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
bil. SEK	121.7	129.9	121.6	120.1	124.6	125.5	128.0	124.9	135.6	141.5	155.5
% GDP	3.25	3.49	3.44	3.21	3.24	3.28	3.30	3.14	3.26	3.30	3.33

The business enterprise sector accounted for SEK 110.9 billion (EUR 10.42 billion), just under 71 percent, of total intramural R&D expenditure. The higher education sector performed R&D for SEK 38.8 billion (EUR 3.65 billion), while R&D expenditure in the government sector amounted to SEK 5.6 billion (EUR 0.53 billion), not including ALF funding. The private non-profit sector conducted R&D for SEK 185 million (EUR 17.39 billion) (41).

The Table 24 contains information on Intramural R&D expenditures, EUR million by industrial classification NACE Rev. 2 for every other year. Dashes in several cells represent inaccessibility of the data.

**Table 24: Intramural R&D expenditures, EUR million by industrial classification NACE Rev. 2**  
(Source: 41).

Industry	2007	2009	2011	2013	2015	2017
SA all industries	7534.25	7737.34	7891.38	8263.33	9190.49	10667.21
01-43 manufacturing enterprises	5312.21	5795.70	5666.17	5914.16	6485.06	5931.47
01-09 enterprises in agriculture, forestry and fishing; mines and quarries	29.62	31.44	35.39	35.87	32.98	36.44
10-12 food product, beverage and tobacco industry	39.23	36.25	39.81	40.68	-	43.37
13-16+18 textile industry;	15.00	11.35	8.17	12.31	26.25	28.56
17 industry for paper and paper products	210.30	313.29	87.41	113.08	-	125.49
19-20 manufacture of refined Petroleum and chemical industry	174.82	181.36	163.66	193.66	140.78	175.78
21 industry for basic pharmaceutical products and pharmaceutical preparations	819.08	607.63	745.42	669.36	-	-
22 industry for rubber and plastic products	16.73	22.98	20.39	24.81	48.08	77.50
23 industry for other non-metallic mineral products	7.69	10.29	12.40	13.56	-	13.46
24 industry for basic metals	134.43	150.30	143.18	207.03	204.24	159.82
25-28 industry for fabricated metal products	2323.39	2732.45	2719.28	2668.32	2952.95	1516.72
29-30 industry for transport equipment	1328.44	1482.68	1521.52	1742.50	1954.62	2817.75
31-32 other manufacturing industries	110.29	103.66	110.29	128.76	109.14	94.62
33 repair shops and installation enterprises for machinery and equipment	55.77	84.14	35.29	8.65	-	-
35-39 energy and recycling	9.04	11.35	9.04	31.73	68.85	80.20
41-43 construction	38.46	16.35	15.00	23.56	34.33	-

R&D Tax incentives in Sweden are presented by lowering the employer social security contributions for employees engaged in R&D. The reduction is presented in the monthly employer return. This incentive works from 1<sup>st</sup> January 2014 and the main aim of this relief is to stimulate investment in R&D activities (42).

### 2.9.1 R&D support in the automotive industry in Sweden

According to OECD data (Table 25), the total investment in R&D of the automotive industry in Sweden in 2007-2017 amounted from 17 to 26% of the total investment in R&D in the same period. In 2007-2015, the growth of investment annually was about 1-2%, increasing rapidly by 4.8% in the 2017. Dashes in several cells of the table represent inaccessibility of the data.

The largest shares of all automotive R&D investments are investments from business enterprise sector. During 2007-2017, the percentage of such investments was fairly stable and amounted from 52.2% in 2007 to 56.7% in 2011. In 2017 the share of these investments increased by 0.75% compared with 2007.

**Table 25: Intramural R&D expenditure in the automotive industry by source of funds, mil. EUR (Source: 39).**

Source of funds	2007	2009	2011	2013	2015	2017
Business enterprise sector	694.17	774.95	865.53	949.57	1035.25	1460.93
Rest of the world (ROW)	201.07	168.76	181.93	164.78	155.22	145.65
Government sector	17.79	27.41	19.62	23.43	24.34	25.26
Higher education sector	-	-	0.00	0.77	1.54	1.25
<b>Total funding in automotive industry</b>	1328.44	1482.68	1521.52	1742.50	1954.62	2817.75
<b>Total funding in the R&amp;D</b>	7534.25	7737.34	7891.38	8263.33	9190.49	10667.21

As can be seen from the Table 26, most of the expenditures are directed to the development of new and existing products and services (87.5%). Next 9.3% of the funds are purposed for development and improving of processes and systems and only 3.2% of the total expenditures are spent on knowledge accumulation.

**Table 26: Intramural R&D expenditures, EUR million in the automotive industry by purpose, every other year (Source: 42).**

	2007	2009	2011	2013	2015	2017
all purposes	1328.44	1482.68	1521.52	1742.50	1954.62	2817.75
development of existing products and services that are new for the company	277.51	381.56	335.21	684.27	403.68	762.16
development of products and services new to the market	140.10	233.67	286.94	268.19	618.88	851.10
improvement of existing products and services	589.74	463.20	473.68	630.61	730.23	852.93
development of new processes, systems, etc	114.53	101.54	138.08	56.83	-	131.83
improvement of existing processes, systems, etc	160.10	264.24	265.30	68.08	86.06	131.26
general knowledge accumulation	46.35	38.46	22.31	34.52	-	88.47

## 2.9.2 Analysis of enterprises using R&D

The following chapter shows the basic economic indicators of enterprises spending on R&D and non-R&D enterprises in 2014-2016 and analyzed the ratio of enterprises in Sweden use or do not use R&D In the automotive industry 51.0% and 50.4% of all manufacturers are spending on the R&D. According to Amadeus database (18), total amount of manufacturing enterprises is 30,922, among which more than 61.6% (19,071 enterprises) are small enterprises with 1-50 employees, of them – 418 enterprises involved in the automotive industry.

### Basic indicators of enterprises spending on R&D

**Table 27: Basic indicators R&D (Source: 18, 39).**

Indicator	Number of enterprises	Revenues			Number of employees		
		2014	2016	2016/2014	2014	2016	2016/2014
		Mil EUR		%	Thousand		%
<b>Manufacturing (total)</b>	15583	119058	131965	110.5	342.6	374.1	109.2
<b>Automotive industry</b>	374	24913	30607	122.9	49.0.1	53.5	108.3

As can be seen from the table, of all Manufacturing enterprises only 3.53% belong to the automotive industry. In 2014 the automotive industry enterprises brought 20.9% of all manufacturers' revenues. This indicator rose up to 23.2% by the 2016. In the years 2014-2016, annual growth in the incomes of automotive enterprises using R&D was 22.9% against the whole manufacturing revenues growth of 10.5%.

Approximately 14.3% of all employees working in manufacturing enterprises spending on the R&D were employed in the automotive industry in the 2014 and 2016. In the years 2014-2016 the automotive industry showed increase of employees by 8.03%.

### Basic indicators of enterprises not spending on R&D

**Table 28: Basic indicators of enterprises not using R&D** (Source: 18, 42).

Indicator	Number of enterprises	Revenues			Number of employees		
		2014	2016	2016/2014	2014	2016	2016/2014
		Mil EUR		%	Thousand		%
<b>Manufacturing (total)</b>	15339	36800	44734	121.6	30.7	32.9	107.6
<b>Automotive industry</b>	359	10047	13753	137	10.9	9.5	87

Table 38 shows that of all manufacturing enterprises only 2.3% belong to the automotive industry. In the 2014 automotive industry enterprises brought 27.3% of all Manufacturers' revenues. This indicator grew to 30.74% in the 2016. In the years 2014-2016, the percentage growth in the incomes of automotive enterprises using R&D was higher by 14.5% against the whole manufacturing revenues growth.

Approximately 35.5% of all employees working in manufacturing enterprises not spending on the R&D were employed in the automotive industry in the 2014. In the 2016 this indicator was 28.8%. In the years 2014-2016, the percentage relation in the amount of employees in automotive enterprises that do not use R&D decreased by 13.0% against the whole manufacturing revenues growth.

## Comparison of R&D and non R&D enterprises in the Manufacturing sector

**Table 29 Comparison of R&D and non R&D enterprises in the Manufacturing sector**  
(Source: on the base of 18).

Indicator	Number of enterprises	Revenues			Number of employees		
		2014	2016	2016/2014	2014	2016	2016/2014
		Mil Eur		%	Thousand		%
<b>Manufacturing with R&amp;D</b>	15583	119058	131965	110.5	342.6	374.1	109.2
<b>Manufacturing without R&amp;D</b>	15339	36800	44734	121.5	30.7	32.9	107.6

In the 2016 total number of manufacturing enterprises was 30922, of which 50.4% enterprises spending on R&D. Total revenues in 2014 were 155,858 mil EUR, where R&D manufacturers took 76.4%. Year 2016 was marked by growth of total sales up to 176,699 mil EUR, where R&D manufacturers had 74.7% of total revenues. In the years 2014-2016, the percentage growth in the incomes of manufacturers using R&D was lower by 2.0% against the manufacturers that do not use R&D. However comparing total revenues shows impressive difference between R&D and non-R&D spending manufacturers.

In the 2014 total number of employees, working in manufacturing enterprises was 363,300 employees, of which 91.6% employed in R&D spending enterprises. Year 2016 was marked by growth of total employment up to 407,000 employees, where employees working at R&D manufacturers composed 91.9% of total employees. In the years 2014-2016, the percentage growth in the employment of manufacturers using R&D was higher by 1.5% against the manufacturers that do not use R&D.

## Comparison of R&D and non R&D enterprises in the Automotive industry

**Table 30 Comparison of R&D and non R&D enterprises in the Automotive industry**

(Source: on the base of 18).

Indicator	Number of enterprises	Revenues			Number of employees		
		2014	2016	2016/2014	2014	2016	2016/2014
		Mil Eur		%	Thousand		%
<b>Enterprises spending on R&amp;D</b>	374	24913	30607	122.9	49	53.5	108.3
<b>Enterprises not spending on R&amp;D</b>	359	10047	13753	137	10.9	9.5	87

In the 2016 total number of enterprises in Automotive industry was 733, of which 51.0% enterprises spending on R&D. Total revenues in 2014 were 34 960 mil EUR, where R&D Automotive took 71.3%. Year 2016 was marked by growth of total sales up to 44,360.mil EUR, where R&D enterprises in automotive industry had 68.9% of total revenues. In the years 2014-2016, the percentage growth in the incomes of enterprises in Automotive industry using R&D was lower by 14.1% against the enterprises in Automotive industry that do not use R&D. However comparing total revenues shows impressive difference between R&D and non-R&D spending enterprises in Automotive industry.

In the 2014 total number of employees working in Automotive industry enterprises was 59 900 employees, of which 81.7% employed in enterprises spending on R&D. Year 2016 was marked by growth of total employment up to 63 000 employees, where employees working at R&D enterprises in Automotive industry composed 84.9% of total employees. In the years 2014-2016, the percentage growth in the employment of manufacturers using R&D was 13.0% against the decrease of manufacturers that do not use R&D.

From tables above can be seen that all manufacturers, including Automotive industry enterprises, which invest in R&D have much higher revenues and employment rate in comparison with manufacturers which spend no money for R&D.

## 2.10 Research and development in the Czech Republic

According to the Czech Statistical Office, the year 2016 was characterized by a significant 10% decline in R&D spending due to a temporary weakening of EU money (Table 31). Between 2012 and 2015, more than EUR 389.4 million has flown from the EU to Czech research every year. These funds were financed from the EU Structural Funds within the 2007–2013 programming period, which could be used until 2015.

In 2016, the above-mentioned more than 10 billion outages in the supply of European money followed. Although the following programming period 2014–2020 has already been officially launched, the amount of funds intended for R&D support is again being prepared, but the drawdown was again slow in the Czech Republic. The fact is that R&D expenditures increased by a significant EUR 397.2 million year on year (13% year-on-year increase) and thus even exceeded 2015. Total R&D expenditure in the Czech Republic for the first time exceeded EUR 350 million.

**Table 31: R&D expenditures 2007-2017** (Source: 23).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>mil.</b>	50	49	50	52	62	72	77	85	88	80	90
<b>CZK</b>	009	872	875	974	753	360	853	104	663	109	386
<b>% GDP</b>	1,30%	1,24%	1,29%	1,34%	1,56%	1,78%	1,90%	1,97%	1,93%	1,68%	1,79%

There have been several trends in the positive development. First of all, the amount of money investing in research is increasing. Business R&D expenditure has been growing continuously since 2009, most in foreign-controlled enterprises. In 2017, there also was a significant increase in public domestic sources, which in the previous three years ranged from EUR 1.0–1.2 million a year, to more than EUR 1.2 million in 2017 and by 9.5% year on year. Public foreign sources, which are mainly hidden by the above-mentioned EU structural funds, also increased year on year and it can be estimated that they will increase significantly in the coming years with regard to the expected intensified drawing of funds from the 2014-2020 programming period.

## 2.10.1 Indirect public support for research and development in Czech Republic

In 2017, total Gross domestic expenditure on R&D (GERD) in the Czech Republic reached a record value of EUR 3.5 billion (EUR 2.1 billion). Compared to 2016, R&D expenditures in private enterprises increased by 15.7%. Since 2010, private R&D expenditure has been continuously rising at an average annual rate of 10% (23).

**Table 32: Number of private enterprises using indirect public support** (Source: 23).

Ownership of the enterprise (CZ-NACE)	2010	2011	2012	2013	2014	2015	2016	2017
<b>Private domestic</b>	<b>514</b>	<b>606</b>	<b>716</b>	<b>796</b>	<b>902</b>	<b>938</b>	<b>889</b>	<b>798</b>
Manufacturing (CZ NACE: C)	286	332	402	454	535	550	523	448
Information and Communication (CZ NACE: J)	85	98	107	108	120	126	142	136
Professional, Scientific and Technical activities(CZ NACE: M)	60	75	90	95	99	106	95	100
Other areas	83	101	117	139	148	156	129	114
<b>Private foreign</b>	<b>202</b>	<b>253</b>	<b>305</b>	<b>324</b>	<b>362</b>	<b>368</b>	<b>359</b>	<b>337</b>
Manufacturing (CZ NACE: C)	127	154	201	210	232	235	232	210
Information and Communication (CZ NACE: J)	20	30	32	28	35	35	38	32
Professional, Scientific and Technical activities (CZ NACE: M)	25	33	34	38	38	45	45	46
Other areas	30	36	38	48	57	53	44	49
<b>Enterprises in total</b>	<b>716</b>	<b>859</b>	<b>1 021</b>	<b>1 120</b>	<b>1 264</b>	<b>1 306</b>	<b>1 248</b>	<b>1 135</b>
Manufacturing (CZ NACE: C)	413	486	603	664	767	785	755	658
Information and Communication (CZ NACE: J)	105	128	139	136	155	161	180	168
Professional, Scientific and Technical activities (CZ NACE: M)	85	108	124	133	137	151	140	146
Other areas	113	137	155	187	205	209	173	163

Domestic-controlled enterprises prefer indirect public support for R&D over direct public support (Table 32). In 2017, 798 domestic enterprises benefited from indirect public support for R&D, claiming R&D tax deductions of EUR 4,304 million, which

represents 32.5% of the total amount of tax deductions in private enterprises. Thus, on average, R&D tax deductions amounted to EUR 11.67 thousands per enterprise. Manufacturing enterprises account for more than 56% of the total domestic-controlled enterprises.

In 2017, 337 foreign-controlled enterprises benefited from indirect public support for R&D, claiming R&D tax deductions of EUR 8,937 million, which represents 67.5% of the total amount of tax deductions in private enterprises. Thus, on average, R&D tax deductions amounted to EUR 26.5 thousands per enterprise.

It should be noted that despite the fact that a greater number of domestic-controlled enterprises use R&D tax support, foreign-controlled enterprises are leading in terms of total amount of such support.

Compared to 2016, there was a decrease in the number of private enterprises using indirect public support for their R&D (Table 33). The level of indirect public support of R&D in comparison with the previous year 2016 increased most significantly in the category of foreign manufacturing enterprises (in absolute terms by EUR 1.5 million; by 12%). In the other category, indirect R&D support decreased by 17.1% (-0.88 million EUR) year-on-year. Between 2007 and 2017, private enterprises saved more than EUR 90.11 million thanks to R&D tax incentives. They received EUR 1,557.7 million from the state budget for their research and development. In total, the Czech state supported R&D in private enterprises in the amount of EUR 2315 million during this period (23).

**Table 33: Income tax deductions from expenditures used on R&D projects implementation**  
(CZK million) (Source: 23).

Ownership of the enterprise (CZ-NACE)	2010	2011	2012	2013	2014	2015	2016	2017
Private domestic in total	2 277	2 821	3 453	4 155	4 635	5 520	5 191	4 304
Manufacturing (CZ NACE: C)	1 605	1 935	2 286	2 738	3 205	3 641	3 321	2 553
Information and Communication (CZ NACE: J)	337	465	548	730	710	1 068	1 110	933
Professional, Scientific and Technical activities (CZ NACE: M)	162	199	324	309	353	395	373	388
Other areas	173	222	296	378	367	415	387	429
<b>Private foreign</b>	<b>4 654</b>	<b>6 844</b>	<b>6 982</b>	<b>7 935</b>	<b>7 277</b>	<b>7 768</b>	<b>7 359</b>	<b>8 937</b>
Manufacturing (CZ NACE: C)	3 732	5 175	5 282	6 141	5 339	5 445	5 058	6 813
Information and Communication (CZ NACE: J)	248	501	428	545	674	1 014	684	608
Professional, Scientific and Technical activities (CZ NACE: M)	187	320	447	588	703	853	970	1 021
Other areas	487	848	825	660	561	456	647	496
<b>Enterprises in total</b>	<b>6 931</b>	<b>9 665</b>	<b>10 435</b>	<b>12 090</b>	<b>11 912</b>	<b>13 287</b>	<b>12 550</b>	<b>13 241</b>
Manufacturing (CZ NACE: C)	5 337	7 110	7 568	8 879	8 544	9 086	8 379	9 366
Information and Communication (CZ NACE: J)	585	966	976	1 275	1 384	2 082	1 793	1 541
Professional, Scientific and Technical activities (CZ NACE: M)	349	519	770	897	1 057	1 248	1 343	1 409
Other areas	659	1 070	1 121	1 039	928	871	1 035	925

Table below shows a more detailed breakdown of indirect public support in various industries categories of production in C-category (Manufacturing) of CZ-NACE codes. The automotive industry (code C-29) enterprises account for 39.8% of the total number of Manufacturing enterprises.

**Table 34: Indirect public support of R&D in private enterprises in the Czech Republic by CZ-NACE prevailing economic activity (Source:18).**

By industry	2010	2011	2012	2013	2014	2015	2016	2017
Manufacturing (CZ NACE: C)	1 014	1 356	1 440	1 689	1 625	1 727	1 592	1 781
Food & Beverage (10-12)	8	11	22	24	26	19	20	17
Clothing, Textiles and Footwear (13-15)	7	6	6	9	13	13	20	19
Wood & Paper Industry (16-17, 31)	2	8	7	9	12	13	9	7
Petrochemical and Chemical Industry (19-20)	16	23	38	63	87	86	82	60
Pharmaceutical Industry (21)	101	51	52	75	88	61	69	57
Rubber and Plastics Industry (22)	12	16	27	49	54	54	53	49
Glass, Ceramics, Porcelain and Building Materials Industry (23)	17	21	29	34	30	36	46	14
Metallurgical Industry (24)	5	14	8	18	15	22	16	8
Manufacture of fabricated metal products (25)	45	48	64	84	108	109	108	83
Electronics Industry (26)	45	48	66	73	83	94	88	89
Electrical Engineering (27)	65	98	133	208	179	188	173	201
Engineering Industry (28)	124	213	285	239	276	265	258	299
Automotive (29)	414	560	541	613	471	529	455	710
Manufacture of other transport equipment (30)	138	207	107	116	120	137	128	106
Other manufacturing (18, 32, 33)	15	30	56	76	63	100	68	62
Information and communication activities (CZ NACE: J)	112	186	186	242	263	400	344	294
Professional, scientific and technical activities (CZ NACE: M)	67	99	147	172	203	238	256	269
Other industries	125	203	213	198	176	165	197	176

According to OECD data (Table 35), the total investment in R&D of the automotive industry in the Czech Republic in 2007-2017 ranged from 12 to 16% of the total investment in R&D in the same period. In 2007-2015 change in investment volumes fluctuated around 1%, increasing rapidly by 63.6% in the 2013.

The largest shares of all automotive R&D investments are investments from business enterprise sector. During 2008-2017, the percentage of such investments was fairly stable and amounted from 80.0% in 2017 to 84.0% in 2011 and 2013. The sharp drop in

investment of almost 25% in 2009 is a consequence of the 2008 economic crisis. In 2017 the share of these investments decreased by 17.0% compared with 2007.

**Table 35: Intramural R&D expenditure in the automotive industry by source of funds, mil. EUR (Source: 39).**

Source of funds	2007	2009	2011	2013	2015	2017
Business enterprise sector	153.01	114.52	129.57	212.51	228.21	242.08
Rest of the world (ROW)	0.94	19.00	21.71	38.14	45.62	57.64
Government sector	3.76	4.33	3.39	1.83	1.94	1.21
Higher education sector	0.00	0.00	0.00	0.06	0.05	0.04
<b>Total funding in the automotive industry</b>	<b>157.71</b>	<b>137.85</b>	<b>154.67</b>	<b>252.54</b>	<b>275.82</b>	<b>300.99</b>
<b>Total funding in the R&amp;D</b>	<b>1120.03</b>	<b>1092.62</b>	<b>1326.58</b>	<b>1612.69</b>	<b>1870.43</b>	<b>2010.73</b>

R&D Tax incentives is also important for private enterprises operating in the area of Information and Communication Activities, in short providing IT services [CZ-NACE J] and Professional, Scientific and Technical Activities [CZ-NACE M]. In the area of IT services, 168 enterprises benefited from R&D tax relief in 2017, which received indirect public R&D support of EUR 11.4 million. Compared to the previous year, the possibility of deducting R&D expenditures from the tax base by 12 private enterprises was less and the amount of indirect R&D support decreased by 14% (in absolute terms by EUR 1.87 million less) (23).

In manufacturing, tax deductibility of R&D expenditure was mostly applied to private enterprises (158 entities) in the engineering industry (CZ-NACE 28). Of all R&D performing enterprises in the engineering industry, of which we have information from the research and development survey (VTR 5-01), less than half (41%) used indirect public support for R&D in 2017. Enterprises in this sector claimed tax support for their R&D activities in the amount of EUR 11.6 million.

**Table 36: Indirect public support of R&D in private enterprises in the Czech Republic by region**  
(Source: 18).

	2010	2011	2012	2013	2014	2015	2016	2017
<b>Prague</b>	282	482	555	653	636	854	784	718
<b>Central Bohemia</b>	474	577	523	630	509	527	421	629
<b>South Moravian</b>	81	109	137	178	179	210	205	182
<b>Liberec</b>	47	56	82	111	113	141	152	169
<b>Highland</b>	25	37	138	97	96	86	94	159
<b>Zlin</b>	31	44	67	102	127	130	149	152
<b>Moravian Silesian</b>	91	137	76	100	131	135	163	146
<b>Plzen</b>	153	234	176	170	170	182	154	127
<b>Pardubice</b>	54	71	107	101	111	96	81	62
<b>Hradec Kralove</b>	22	30	33	51	64	51	52	55
<b>Olomouc</b>	27	43	45	50	39	45	53	37
<b>South Bohemian</b>	11	10	15	20	33	33	38	30
<b>Karlovy Vary</b>	4	3	9	18	22	14	25	27
<b>Usti nad Labem</b>	16	12	23	20	39	26	19	27

By comparing the number of private enterprises that used R&D tax support in 2017 in individual regions of the Czech Republic (Table 36), we find that the largest number of them were in Prague (718). The capital city is followed by the Central Bohemian Region with 629 enterprises. The least number of entities that applied the deduction of R&D expenditure came from the Karlovy Vary and Usti nad Labem Regions (only 27 enterprises in each region).

In private enterprises, which in 2017 used the possibility of applying tax deductions for R&D expenditures, enterprises operating in manufacturing (CZ-NACE C) prevailed in all regions except the capital city of Prague. Prague is characterized by a strong presence of research and development enterprises in the field of information and communication technologies (CZ-NACE J). 140 of the 580 private businesses in the region were involved in research and development in this sector (23).

Of the total amount of indirect public support for R&D acquired by private enterprises in the Czech Republic, almost one third (EUR 27.9 million) was allocated to enterprises based in the capital. Of this amount, IT services enterprises (CZ-NACE J) received one

quarter (EUR 7.2 million). Private enterprises in the manufacturing industry claimed R&D tax support of EUR 8.7 million (31% within the region).

Only the Central Bohemian Region (EUR 24.5 million) surpassed the half-billion CZK border (in equivalent). Almost all R&D tax support (97%; EUR 23.7 million) was acquired by enterprises in manufacturing. In particular, R&D performing enterprises in the automotive sector play a significant role. The bulk of indirect public support for R&D in the Central Bohemian Region was directed to foreign-controlled enterprises (94%; EUR 23.0 million). Compared to the previous year, indirect public support for R&D in this region increased by a significant 49% (by EUR 8.1 million in absolute terms) (23).

### **2.10.2 Share of indirect public R&D support on gross domestic product**

The highest share of indirect public support of R&D in relation to GDP was achieved in 2016 from selected OECD countries in Belgium (0.30%). The Czech Republic found itself at the level of Sweden (0.05%, 2014) and Spain (0.03%) with indirect public R&D support to GDP of 0.05%. Within the new EU member states that joined the EU in 2004, only Slovenia (0.12%) and Hungary (0.09%) are better than the Czech Republic, with more than double share than the Czech Republic. By contrast, Slovakia has a significantly smaller share (0.005%) compared to the Czech Republic (41).

In the countries that joined the EU after 2004, R&D tax support has not been used so far. In Bulgaria and Croatia, this instrument is not yet in place. In Romania, the share of GDP reaches the level of units per mile.

The share of indirect public support for R&D in relation to GDP in most of the countries that invest most in R&D tended to decline between 2014 and 2016. A faster GDP growth rate than the growth rate of indirect public R&D support played a role. The only exception is the fast-growing China, where enterprises increased their R&D spending by 12% between 2015 and 2016 to 349,685 in million USD in purchasing power parity.

### 2.10.3 Analysis of enterprises using R&D

The following chapter shows the basic economic indicators of enterprises spending on R&D and non-R&D enterprises in 2014-2016 and analyzed the reasons why enterprises in the Czech Republic use or do not use R&D In the automotive industry 52.7% and 16.7% of all manufacturers are spending on the R&D. According to Amadeus database (18), total amount of manufacturing enterprises is 31,875, among which more than 88.9% (28,345 enterprises) are small enterprises with 1-50 employees, of them – 258 enterprises involved in the automotive industry.

#### Basic indicators of enterprises spending on R&D

Table 37: Basic indicators R&D (Source: 18).

Indicator	Number of enterprises	Revenues			Number of employees		
		2014	2016	2016/2014	2014	2016	2016/2014
		Mil EUR		%	Thousand		%
<b>Manufacturing (total)</b>	4530	155395	164728	106	994	1061	106,7
<b>Automotive industry</b>	357	30147	36192	120	108,6	130,7	120

As can be seen from the table, of all Manufacturing enterprises only 7.9% belong to the automotive industry. In the 2014 automotive industry enterprises brought 19.4% of all manufacturers' revenues. This indicator rose up to 21.9% by the 2016. In the years 2014-2016, the percentage growth in the incomes of automotive enterprises using R&D was higher by 14% against the whole manufacturing revenues growth.

Approximately 11.0% of all employees working in manufacturing enterprises using R&D were employed in the automotive industry in the 2014. In the 2016 this indicator was 12.3%. In the years 2014-2016, the percentage growth in the amount of employees in automotive enterprises using R&D was higher by 4.3% against the whole manufacturing revenues growth.

## Basic indicators of enterprises not spending on R&D

Table 38: Basic indicators of enterprises not using R&D (Source: 18).

Indicator	Number of enterprises	Revenues			Number of employees		
		2014	2016	2016/2014	2014	2016	2016/2014
		Mil EUR		%	Thousand		%
<b>Manufacturing (total)</b>	27345	52862	59205	112	471	485	103
<b>Automotive industry</b>	321	7531	10079	133	36.4	34.3	94

As can be seen from the table, of all Manufacturing enterprises only 1.2% belong to the automotive industry. In the 2014 automotive industry enterprises brought 14.2% of all Manufacturers' revenues. This indicator rose up to 17.0% by the 2016. In the years 2014-2016, the percentage growth in the incomes of automotive enterprises using R&D was higher by 21.0% against the whole manufacturing revenues growth.

Approximately 7.7% of all employees working in manufacturing enterprises using R&D were employed in the automotive industry in the 2014. In the 2016 this indicator was 7.1%. In the years 2014-2016, the percentage relation in the amount of employees in automotive enterprises that do not spend on the R&D, decreased by 6.0% against the whole manufacturing revenues growth.

## Comparison of R&D and non R&D enterprises in the Manufacturing sector

Table 39 Comparison of R&D and non R&D enterprises in the Manufacturing sector (Source: on the base of 18).

Indicator	Number of enterprises	Revenues			Number of employees		
		2014	2016	2016/2014	2014	2016	2016/2014
		Mil Eur		%	Thousand		%
<b>Manufacturing with R&amp;D</b>	4530	155395	164728	106	994	1061	106,7
<b>Manufacturing without R&amp;D</b>	27345	52862	59205	112	471	485	103

In the 2016 total number of manufacturing enterprises was 31 875, of which 14,2% enterprises spending on R&D. Total revenues in 2014 were 208 257 mil EUR, where R&D manufacturers took 74.6%. Year 2016 was marked by growth of total sales up to 223 933 mil EUR, where R&D manufacturers had 73.6% of total revenues. In the years 2014-2016, the percentage growth in the incomes of manufacturers using R&D was lower by 6.0% against the manufacturers that do not use R&D. However comparing total revenues shows impressive difference between R&D and non-R&D spending manufacturers.

In the 2014 total number of employees, working in manufacturing enterprises was 1 465 000 employees, of which 67.8% employed in R&D spending enterprises. Year 2016 was marked by growth of total employment up to 1 546 000 employees, where employees working at R&D manufacturers composed 68.6% of total employees. In the years 2014-2016, the percentage growth in the employment of manufacturers using R&D was higher by 3.7% against the manufacturers that do not use R&D.

### Comparison of R&D and non R&D enterprises in the automotive industry

Table 40 Comparison of R&D and non R&D enterprises in the automotive industry (Source: 18).

Indicator	Number of enterprises	Revenues			Number of employees		
		2014	2016	2016/2014	2014	2016	2016/2014
		Mil Eur		%	Thousand		%
<b>Enterprises spending on R&amp;D</b>	357	30147	36192	120	108.6	130.7	120
<b>Enterprises not spending on R&amp;D</b>	321	7531	10079	133	36.4	34.3	94

In the 2016 total number of enterprises in Automotive industry was 678, of which 52.7% enterprises spending on R&D (Table 40). Total revenues in 2014 were 37 678 mil EUR, where R&D Automotive took 80.2%. Year 2016 was marked by growth of total sales up to 46, 271 mil EUR, where R&D enterprises in automotive industry had 78.2% of total revenues. In the years 2014-2016, the percentage growth in the incomes of enterprises in Automotive industry using R&D was lower by 13.0% against the

enterprises in Automotive industry that do not use R&D. However comparing total revenues shows impressive difference between R&D and non-R&D spending enterprises in Automotive industry.

In the 2014 total number of employees working in Automotive industry enterprises was 145 000 employees, of which 74.9% employed in enterprises spending on R&D. Year 2016 was marked by growth of total employment up to 165 000 employees, where employees working at R&D enterprises in Automotive industry composed 79.2% of total employees. In the years 2014-2016, the percentage growth in the employment of manufacturers using R&D was higher by 26.0% against the manufacturers that do not use R&D.

From tables above can be seen that all manufacturers, including automotive industry enterprises, which invest in R&D have much higher revenues and employment rate in comparison with manufacturers which spend no money for R&D.

## **2.11 Trends in the automotive industry**

The automotive industry is undergoing a number of major changes that have the ambition to significantly transform the entire sector. And not only in the form of technological innovations on the cars themselves, but also in the production process and in the current business model.

### **2.11.1 Alternative drives: Electricity, gas and hydrogen**

Every big automaker invests in new drives. Prim plays an electric drive, for example, Škoda Auto supports compressed natural gas (CNG). LNG (Liquefied Natural Gas) is promoted in road freight transport. Especially Japanese automakers again believe in hydrogen (Toyota is already producing Mirai hydrogen in series) and Audi has developed a new eco-diesel, composed only of water and air. The mass expansion of the drive will depend primarily on the availability of pumping / charging stations, the price of the car and the range.

Electromobility: While the cost of a kilometer is between 1 and 3 cents for an electric car, its high development cost, battery life and insufficient number of charging stations

prevent its greater development. European development of electromobility can thus be expected only after 2020, depending on the tightening of the EU emissions target, on technology development (mainly on batteries) or on national policies (already many European countries, led by Germany, already support the purchase of electric vehicles, whether tax advantages, free parking, car purchase subsidies, etc.).

### **2.11.2 New technologies: Connectivity and autonomous control systems**

The most user-friendly innovations are in connecting cars with mobile phones and applications and in autonomous management systems. It is now possible not only to connect and synchronize the car with the smartphone, but also to control it through the car (eg Mazda offers a system that allows the phone to start the engine). Thanks to advanced sensors, autonomous steering systems help keep the car in lanes, emergency braking, tracking nearby buildings, parking or entering a garage.

Self-driving cars are already being tested by Audi, BMW, Toyota, Mercedes, but also by Google's internet. Yet their commissioning is still a question of at least 2025, not least because it is not yet clear who will be responsible for any accidents. In the near future, however, the connection of cars and their navigation to GPS and the development of smart traffic management systems, including car-to-car communication, will develop.

One of the consequences of developing new technologies could be the arrival of new entrants in the industry (especially from the IT sector such as Google), but they will have to spend huge amounts of money to develop their cars.

### **2.11.3 Industry 4.0: Production Digitization**

A great opportunity for the Czech automotive industry is the so-called Revolution in the Industry – Industry 4.0, consisting in its digitization. In practice, this means connecting all intelligent devices, production lines and products, all production systems, warehouses, logistics and service to a single intelligent information network, where smart devices of customers, manufacturers and suppliers will communicate and respond to each other without human assistance real-time clients.

In just a few years, when you buy a car, people will not go to a car showroom, but at home they will put together a “tailor-made” tailor-made car from all possible components. Just with a significant difference that they don't buy it but rent it for a certain time.

The production process will be carried out in such a way that immediately after ordering, the automotive system will analyze the order and send requests to the component manufacturers. They use the robots to build the car and deliver the finished product automatically. At the same time, the production line will not be owned by the factory, but will be borrowed from the manufacturers. This can be 20 years, 3 months or just a few orders.

Everything is covered by the so-called smart factories, where the ongoing robotization and automation of production will take place, as well as the introduction of chips, sensors or 3D printers, which will increase the productivity of the industry. The role of employees will be mainly in control and cooperation with robots.

#### **2.11.4 Tightening environmental and safety standards**

Tightening of CO<sub>2</sub> discharge requirements (according to EU regulation from today's 130 g / km to 95 g / km in 2021) as well as tightening of safety standards (requirements for mandatory safety equipment, airbags, ABS and ESP - electronic stability control, e-call, which will have to have all the new passenger cars on April 1, 2018, will require major car investment.

According to their estimates, European car manufacturers are expected to spend just 13 billion EUR on their CO<sub>2</sub> discharge requirements. Therefore, automakers are increasingly using new materials such as nanofibers (eg in filters) or carbon fibers, which allow to reduce the weight of vehicles (and thus consumption) while maintaining strength standards.

#### **2.11.5 Continued cost reduction**

Car makers will continue to push for cost reduction and production efficiency, not only in their factories but also in their suppliers. As a result, large automakers will reduce the

number of suppliers to those who are able to deliver parts globally and innovate their products.

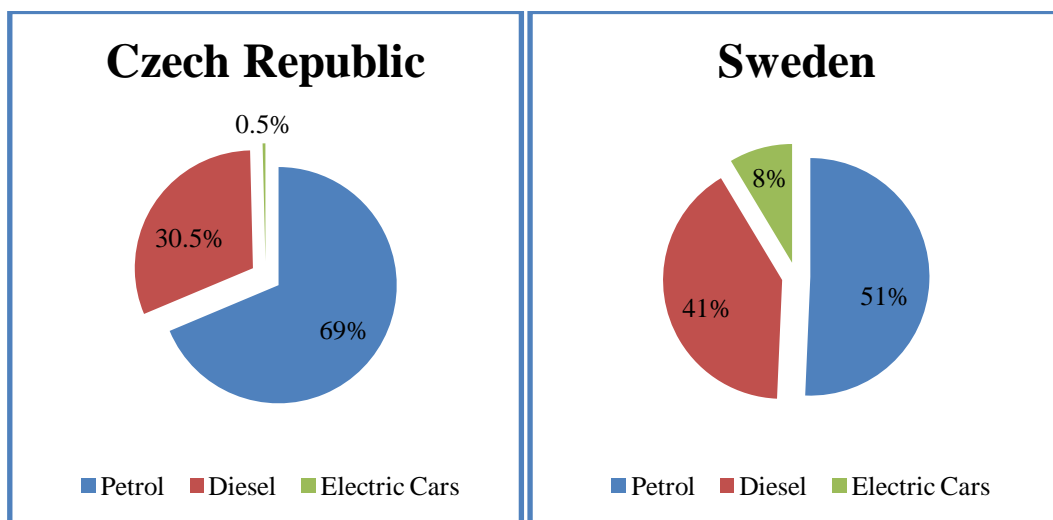
## 2.12 Electric cars

Registrations of diesel cars totalled 261,437 units in the 2017; 1,744 units (or 0.67%) more than during the same period in 2016. In the 2018 this amount fell to 254,267 units, or 2.74% less than 2017. This drop in demand for diesel vehicles was largely offset by an increase in petrol sales. Demand for new petrol cars grew significantly (+9.4%) with petrol sales totalling 175,276 units – roughly 17,000 more than last year.

**Table 41: Fuel types of sold cars 2016-2018** (Source: 29).

	2016			2017			2018		
	Petrol	Diesel	Electric Cars	Petrol	Diesel	Electric Cars	Petrol	Diesel	Electric Cars
<b>Czech Republic</b>	152862	106831	200	158796	102641	387	175276	78991	981
<b>Sweden</b>	138653	233665	2945	149359	186334	19319	166793	133911	28332

According to the Table 41, So far in 2018, CZ demand for alternatively-powered vehicles grew by amazingly high +153.5%. In Sweden the growth was not such effecting - +46.7% comparing to 2017. However the total ratio of diesel-petrol-electric cars in Sweden differs a lot with the Czech Republic.



**Figure 10: The ratio of fuel types for cars sold in 2018** (Source: Table 41).

Demand for alternatively-powered vehicles continues to grow in both Czech Republic and Sweden.

One of the reasons why the increase in the purchase of electric cars in the Czech Republic is so small is the price. For example, three of the best selling electric cars in Europe are (39):

- Nissan Leaf costs at least 36 538 EUR,
- Renault Zoe costs 32 192 EUR
- VW e-Golf from 38 227 EUR.

In contrast, in the Czech Republic, the best-selling model with conventional drive, the Škoda Octavia, starts at 16 842 EUR and the new Scala at 14 231 EUR.

However, the price is not the only reason why the sale of electric cars in the Czech Republic is weak. Most interviewees are also worried about the technical specifics of electric cars. In particular, there is a lack of electric cars and a short battery life. The problem is also the short range of these vehicles and few charging stations, which do not compensate for the lower costs of operating cars.

In my opinion, state aid could convince motorists to purchase electric vehicles. It operates in a number of countries - such as tax benefits, purchase allowances, and other benefits. In the case of state support, most people would be willing to buy an electric car that would cost about 1 500 EUR against a classic car.

No Czech electric car is mentioned in this sub-chapter due to the fact that at the moment no Czech automotive enterprise has produced an Czech electric cars. Only Skoda automotive in the beginning of spring 2019 presented render of the 1<sup>st</sup> Skoda electric car. On the contrary, the biggest Swedish enterprise Volvo group has wide range of electric cars.

### **2.12.1 Charging stations in 2018**

The charges for the electric car must be known when analyzing pros and cons. Accordingly, the presence and wideness of public chargers for electric cars is extremely important for choosing between an electric car and petrol or diesel car.

In 2018 Sweden was in 4<sup>th</sup> place in terms of the number of public charging stations in the country. It had 5674 charging stations in 1478 locations. On the contrary, the Czech Republic is located much lower on the list than Sweden. In 2018 the number of charging stations was 528 in 421 locations.

### **2.12.2 Advantages of electric cars**

- Reducing or even eliminating fuel costs

Not only is electricity less expensive than gasoline, it also has a much more stable price point, meaning that rapid price swings are all but eliminated by going electric.

- Reduce car emissions to help the environment

Electric vehicles can be fuelled by electricity from renewable sources, such as wind, hydropower, and solar, while gasoline can only be produced through intensive extraction and transportation processes.

- Energy independency

Electric vehicles are fuelled by connecting to the electric grid, and electricity can be produced through several generation methods.

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### 3. Comparison of chosen policy

The Czech Republic is the most industrialised country in Eastern Europe. It is obvious that, comparing to Sweden, Czech Republic has lower economic indicators. This is primarily due to historical facts. However, in comparison with Sweden, Czech Republic grows much faster and apparently will catch up very soon with current 2018 GDP rate of Sweden.

As can be seen from the table below, countries differ in the extent to which they rely on tax measures to support R&D, and those who decide to design substantially different ways for tax relief.

**Table 42: Design of R&D tax incentive support** (Source: 39).

	Sweden	Czech Republic
<b>Tax incentive</b>	Partial exemption of employer social security contributions	
<b>Type of instrument</b>	Volume-based	Hybrid (volume-based and incremental)
<b>Eligible expenditures</b>	Labour	Current and depreciation of movable fixed assets
<b>Headline rates (%)</b>	10	Volume: 100 Increment: 10
<b>Refund</b>	Redeemable against employer social security contributions	No
<b>Carry-over (years)</b>	n.a.	3 (carry-forward)
<b>Thresholds</b>	-	Qualifying R&D expenditure in the previous year
<b>Ceilings</b>	SSC deductions capped at SEK 230,000 per month and company/group (or SEK 2.76 million per year)	no

### **R&D tax relief in Sweden:**

The employer social security contributions are reduced by 10% of the employee's total gross salary paid in particular month. A 25% tax reduction can be granted for foreign key personnel, as well as foreign experts and scientists

### **R&D tax relief in the Czech Republic:**

A taxpayer may deduct up to 110% of the costs associated with the R&D projects from the tax base as a special allowance.

Eligible groups of expenses are:

- Personal expenses of relevant employees
- Tax depreciation of fixed assets used in direct connection with the R&D projects
- Other operational expenses directly related to the project
- Expenses occurred while using services from public R&D organisations
- Travel expenses up to the statutory limits

## **3.1 Suggestions for solution**

Automotive industry is one of the most important industries both in Sweden and in the Czech Republic, so it is so necessary and vital to further develop and support the automotive industry to maintain competitiveness not only in Europe but also on global market. Products received from automotive industry are a big part of the daily life of a whole country.

Increasing investment in Research and Development should lead to increase of innovations in the whole industry.

### **Both governments of the Czech Republic and Sweden should:**

In relation to the Ministry of industry and trade and relevant ministries

Strengthen inter-ministerial coordination for R&D activities and strengthen intergovernmental capacity and resources to rationalize, plan, implement, monitor and evaluate national and regional R&D policies and action plans.

### In relation with entrepreneurs

Facilitate small and medium-sized businesses in the Czech Republic and Sweden higher access to financing projects aimed at R&D activities.

Create other favourable conditions for the functioning of the business. The decrease in interest rates, in turn, will lead to an increase in investment, which has a beneficial effect on entrepreneurial activity. Entrepreneurs for their part rationally organize their business, reducing the costs of production through the introduction of new technologies.

### In relation to tax policy

Create more tax incentives to target commodity production to the domestic market, and high value-added production to focus on exports. The development of export industries, on the one hand, brings revenues to the budget, on the other hand, contributes to the expansion of national production and the emergence of additional jobs.

### **Enterprises should do:**

As indicated in second part of the master's thesis, it can be noted that only a small number of enterprises invests money in R&D. However, nowadays the rate of change in industries is increasing. In order to be competitive enterprise needs not just to keep up with the time but also to develop new products. It is the only way to save their customers. Accordingly, enterprises need to make a budget item for in R&D.

The problem is not only in money. For the future development, appropriate qualifications are needed. Accordingly, a very important aspect is the education of future and current specialists. For example, Skoda Auto created its own university to train future specialists with the necessary qualifications.

Small enterprises should arrange their employees for refresher courses at least once in specified period in order to update their knowledge with new trends.

The technical side of the issue is also very important. Applying new machines will improve productivity of the enterprise. Naturally, the appearance of the new machines should be accompanied by appropriate training.

## **Conclusion**

The aim of this master's thesis was to compare the level of Research and Development policy of the Czech Republic and Sweden.

The first chapter deals with the theoretical basis of the work. It defines the concept of research and development, its benefits and goals. It also defines the automotive industry

The next part is an analysis of the current situation, which compares the production of cars countries, including foreseeable developments in the coming years, compares innovation, industrial employment and other indicators affecting industry and investment into innovation. It also investigates the share of enterprises with innovation activities in the Czech Republic

The analysis shows that employment in industry in the Czech Republic is expected to keep the top spot in the coming years. One of the limiting factors in the growth of production is the shortage skilled workers and few innovative enterprises.

The analysis also includes the current development of new alternative propulsion units could delay the onset of electromobility, which, as mentioned, still has much to improve, to replace the existing internal combustion engines.

The last part deals with the proposals for the Czech Republic, which concern the increase of interest of technical fields and thus ensuring sufficient qualified employees, securing financial support for innovation and investment project proposals for innovation, including assess their risks.

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