CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

Department of Economics

DIPLOMA THESIS

**The Revealed Comparative Advantage
of the Czech automotive Sector**

Author: Ondřej Fiala

Supervisor: doc. Ing. Mansoor Maitah, Ph.D. et Ph.D.

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DIPLOMA THESIS ASSIGNMENT

Ondřej Fiala

Economics and Management

Thesis title

The Revealed Comparative Advantage of the Czech Automotive Sector

Objectives of thesis

The aim of this thesis is to analyze which sub-sectors have a comparative advantage. The thesis will be focused on the period of the years 2001 – 2013.

Methodology

Index analysis, mainly by the RSA (revealed comparative advantage). Descriptive and comparative analysis of selected years of research.

The proposed extent of the thesis
50 – 70 pages

Keywords

sectors, Czech Republic, euro, dollar, economy, national

Recommended information sources

Balassa, B. (1965), Trade liberalization and revealed comparative advantage, The Manchester School of Economic and Social Studies

Lafay, G. (1992), The measurement of revealed comparative advantages, in M. Dagenais and P.-A. Muet, eds, International Trade Modelling, Chapman & Hall

Leromain, E. and G., Orefice (2013), New Revealed Comparative Advantage Index: Dataset and Empirical Distribution. CEPII Working Paper

Vollrath, T. (1991), A Theoretical Evaluation of Alternative Trade Intensity Measures of Revealed Comparative Advantage, in Weltwirtschaftliches Archiv

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doc. Ing. Mansoor Maitah, Ph.D. et Ph.D.

Supervising department
Department of Economics

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prof. Ing. Miroslav Svatoš, CSc.

Head of department

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Ing. Martin Pelikán, Ph.D.

Dean

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Declaration

I declare that the bachelor thesis on topic: "The Revealed Comparative Advantage of the Czech Automotive Sector" was written individually by me, by the help of specific literature and other sources which are included in the review of used material, and by the help of consultations with supervisor doc. Ing. Mansoor Maitah, Ph.D. et Ph.D.

In Prague 26th March 2016

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Signature

The revealed Comparative Advantage of the Czech Automotive Sector

Odhalená komparativní výhoda českého automobilového sektoru

Summary

This thesis focuses on revealed comparative advantage and its calculation for the automotive sector and selected subsectors of the Czech Republic. Hungary was a part of the investigation as well, and there are used its data mainly for a comparison with the Czech Republic. The thesis uses three indices – Balassa, Vollrath, and Lafay index. Each of the three indices is different, and uses different data as well. Balassa index uses only export data, while Vollrath and Lafay indices use export and import data. The research is done from global point of view, as well as from the Visegrad group point of view, and also with comparison of the Czech Republic with Hungary.

Key words: Balassa, Vollrath, Lafay, analysis, USD, comparative, advantage, disadvantage

Souhrn

Tato diplomová práce se zaměřuje na odhalenou komparativní výhodu, a její výpočty pro automobilový sektor a vybrané položky tohoto sektoru pro Českou republiku. Maďarsko je také součástí výzkumu, a jeho data jsou hlavně používané ke srovnání s Českou republikou. Tato diplomová práce využívá tři indexy – Balassův, Vollrathův a Lafayův index. Každý z těchto indexů je jiný a používá jiné data. Balassův index využívá pro výpočet pouze exportní údaje, zatímco Vollrathův a Lafayův index využívají jak data exportní, tak data importní. Výzkum je zhotoven z pohledu globálního, ale také z pohledu Visegrádské skupiny, a také porovnání České republiky s Maďarskem.

Klíčová slova: Balassa, Vollrath, Lafay, analýza, USD, komparativní, výhoda, nevýhoda

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1. Introduction

There is publicly known that the Czech Republic has a long tradition in making cars and other vehicles. The Czech Republic as a car producer and exporter operates in many countries all around the world. Three indices are going to be used in this thesis in order to examine and detect whether the Czech Republic has comparative advantage in making and exporting its automotive sector as a whole group– Balassa, Vollrath, and Lafay. Three different subgroups will be examined and compared as well. The selected subgroups are as followed: Cars, Parts for motor vehicles, and Tractors. Each of the three indices is different, and uses different data as well. Balassa index uses only export data, while Vollrath and Lafay indices use export and import data.

Since the Czech Republic was established in 1993, many things have changed in term of its export and import strategy. The Czech Republic have transformed from centrally planned economy into open economy, and that was followed by many foreign trade agreements with different entities, which helped the Czech Republic to have a higher competitiveness.

There was selected another country to concentrate on – Hungary. Hungary has very similar history as the Czech Republic. Both countries were part of so called the Eastern bloc in Europe. As well as the Czech Republic, Hungary is located in the central Europe and has almost the same number of inhabitants. In both countries, there were done many investments such as by Volkswagen, Audi, Toyota, Mercedes, and other.

2. Thesis Objectives

The main objective of this thesis is to investigate whether the Czech Republic has a comparative advantage or disadvantage of its automotive sector between 2001 and 2014. The investigation will be done from the global point of view as well as from the point of view of the Visegrad group for Balassa and Vollrath indices. The automotive sector is in this thesis represented by the group 87 which represents products as cars, parts for the group 87, buses, motorcycles, and others.

The other objective is to investigate whether the Czech Republic has a comparative advantage in selected subgroups, such as cars (8703), parts (8708), and tractors (8701).

All possible advantages and disadvantages will be shown also graphically for better understanding of the trend between 2001 and 2014. The financial crisis in 2008 has affected many sectors and of course is included in this research.

3. Literature overview

3.1.   Foreign Trade

3.1.1. History and different theories of foreign trade

Theoretical foundation and empirical measures of comparative advantage have long been known by trade economists. The believers of the classical theory of comparative advantage predicted that gains from exchange maximize welfare and free trade would lead to world economic prosperity. Adam Smith, a Scottish professor and the author of the book ´The Wealth of Nations´ published in 1776, was probably the first one who introduced a theory of an absolute advantage. Smith worked only with a labor as a factor that also represents the price of a product. Based on his theory, every country should produce a product that it could be produced using the least labor hours possible. There are of course some countries that do not possess any absolute advantage in producing any product but even these countries can gain from their participation in the global market and exactly this made happen David Ricardo who was inspired by Adam Smith´s theory of an absolute advantage.

There are two basic concepts based on comparative advantages. The first one is a theory of the comparative advantage introduced by David Ricardo, and the second one is the Heckscher-Ohlin theory. However, the determinants of comparative advantage are different among various trade theories. The Ricardian theory used costs and technological differences for explanation of comparative advantage. On the other hand, the Heckscher-Ohlin-Samuelson theory considered factor´s price differences.

In 1817, David Ricardo, an English political economist, introduced a theory of comparative advantage in his book ´Principles of Political Economy and Taxation´ and is regarded as the classical theory of international trade that relies on relative efficiency in producing certain products by a given country. The Ricardian theory differs from the Smith´s absolute advantage in a major point − when a country A possess an absolute advantage in producing two products, it can still be possible and more efficient to produce just one product and the other product import. The reason

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for this change is a fact that every economy has a limited resources – meaning when a country wants to produce another product it needs to sacrifice a potential worker who currently works in production of a different product.

According to the Ricardian classical theory of foreign trade, each country will produce their products for the production of which it is most suited in terms of its natural endowments, climate quality of soil, means of transport, capital, etc. Each country will produce these commodities in excess of its own requirement and will trade the surplus with the imports of goods from other countries for the production of which it is not well suited or which it cannot produce at all. Ricardo suggests that all countries should import these product or commodities in which they do not possess cost advantages and export those commodities in which they have cost advantages.

However, the Ricardian theory includes only one production factor – labor as a full specialization, the Hecker-Ohlin theory, includes two factors – labor and capital. According to Bertil Ohlin and his professor Eli Heckscher, trade arises due to different relative prices of different goods in different countries. Prices of products are different due to different prices of factors. Factor prices differ because endowments – in this case labor and capital – differ among countries. That's why according to Hecker-Ohlin suggest, that trade will occurs because different countries have different factor endowments. (Leontief, 1954)

Computing comparative advantage and validating Hecker-Ohlin theory is not always an easy job and that is why Béla Balassa, a Hungarian economist, came with an idea that there is no reason to take into account all of the factors possessing comparative advantage of a given country. Therefore, in 1965, Balassa introduced a new term ´revealed´ comparative advantage in his book ´*Trade Liberalisation and Revealed Comparative Advantage´*. (Balassa, 1965)

The methods that are based on trade flows can be divided into two groups. The first group only uses export data and the second uses both export and import data. The most widely used indicator in the first group is the Balassa index, as suggested in Balassa (Balassa, 1965), while the most popular in the second is the Lafay index, as

suggested in Lafay (Lafay, 1992). The "revealed comparative advantage" (RCA) approach, firstly introduced by Balassa (Balassa, 1965), suggested that the real pattern of competitiveness can be calculated from post trade export data.. The index is calculated as follows:

$$\text{RCA} = (\ X_{ij} \ / \ X_{it}\ )/(\ X_{nj} \ / \ X_{nt}\ )$$

where X is exports, i – a country, j – a commodity, n – a set of countries (or another country), t – a set of commodities.

RCA is based on export performance and observed trade patterns. At measures a country's exports of a commodity relative to its total exports. Thus if RCA>1, then a comparative advantage is revealed.

Overcoming the shortcomings of Balassa index, the index developed by Vollrath (Vollrath, 1991) allows to assess trade flows also in terms of import. According to Vollrath revealed competitiveness (RC) index is more preferable since supply and demand balances are included in the index. RC is calculated as the difference between relative export advantage (RXA), which is the same as the original Balassa index (RCA), and its opposite, relative import advantage (RMA):

$$\text{RXA} = (\ X_{ij} \ / \ X_{it}\ )/(\ X_{nj} \ / \ X_{nt}\ ),$$

$$\text{RMA} = (\ M_{ij} \ / \ M_{it}\ )/(\ M_{nj} \ / \ M_{nt}\ ),$$

where X – are imports, M – are import, i – a country, j – a commodity, n – a set of countries, t – a set of commodities.

The Vollrath index is formulated as:

$$\text{RC} = \ln\text{RXA} - \ln\text{RMA}$$

There is a big difference in expression of the results in comparison with the Balassa index. Balassa index result is expressed as, if RCA>1, then a comparative advantage is revealed. If RCA<1, then a comparative disadvantage is revealed.

In case of the Vollrath index, **positive results** of the Vollrath index **reveal competitiveness,** and negative values show competitive disadvantage. Balassa and Vollrath approaches rely on different concepts and that is why they are not strictly comparable. (Utkulu, 2004)

The next Lafay index (LFI) of international specialization analyze comparative advantage or disadvantage of a country in a specific good (or subsector, sector) in comparison of the trade balance of the specific good, with total trade balance of the country. While taking into account rate of exchange of the specific good in the total turnover of the total trade. (Lafay, 1992)

The Lafay index does not measure comparative advantage in comparison with other country (or a set of countries). It measures comparative advantage in comparison to the total structure of trade of a given country. Positive values of LFI show comparative advantage of a given product in the total structure of trade of a given country. That means that there will not be that many rows in the final tables because we will measure only comparative advantage (or disadvantage) of a given product within the total structure of trade of a given country. In other word, the LFI combines together trade and production variables. Using this index we consider the difference between each item's normalized trade balance and total normalized trade balance. (Lafay, 1992)

For a given country, *i*, and for any given product *j*, the Lafay index is formulated as:

$$LFI_j^i = 100 \left(\frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_{j=1}^{N}(x_j^i - m_j^i)}{\sum_{j=1}^{N}(x_j^i + m_j^i)} \right) \frac{x_j^i + m_j^i}{\sum_{j=1}^{N}(x_j^i + m_j^i)}$$

3.2.   Selected group 87 – Vehicles other than railway, tramway and its subgroups

The group number 87 – Vehicles other than railway, tramway includes very wide scale of vehicles such as tractors, cars, trucks, as well as parts of motor vehicles,

motorcycles, bicycles, and other. As written in the official name – vehicles other than railway, tramway – the group does not include railways and tramways, these products are included in the group number 86 – Railway, tramway locomotives, rolling stock, equipment. Here downwards, there is attached the full list of sub products included in the group number 87.

87 – Vehicles other than railway, tramway

8701 – Tractors (other than tractors of heading no 8709)

8702 – Public-transport type passenger motor vehicles

8703 – Cars (incl. station wagon)

8704 – Trucks, motor vehicles for the transport of goods

8705 – Special purpose motor vehicles (fire fight vehicles, crane lorry)

8706 – Chassis fitted with engine for motor vehicles

8707 – Bodies for motor vehicles

8708 – Parts and access of motor vehicles

8709 – Work truck, self-propelled, for factories/airport and parts

8710 – Tanks and other armoured fighting vehicles, motorized, and parts

8711 – Motorcycles, side-cars

8712 – Bicycles and other cycles, not motorized

8713 – Invalid carriages (wheelchairs), w/n motorized

8714 – Parts and accessories of motorcycles and cycles

8715 – Baby carriages and parts thereof

8716 – Trailers and semi-trailers; other vehicles not mechanically propelled

This thesis works with all of these products but not with each product individually. There are computed Balassa, Vollrath, and Lafay indices for the group 87 – Vehicles other than railway, tramway as a whole, and some several other. Chosen

were only those that were considered as very important or interesting. Those others are following:

87 – Vehicles other than railway, tramway

8701 – Tractors (other than tractors of heading no 8709)

8703 – Cars (incl. station wagon)

8708 – Parts and access of motor vehicles

The group number **8703** – Cars accounts with its USD 701 037 129 000 for more than 50.7% of global export within the whole group of 87 – Vehicles other than railways with its USD 1 381 625 672 000 (in this case representing 100%) in 2014.

The second choice naturally went for the group number **8708** – Parts and access of motor vehicles with their export share of almost 27% (USD 371 935 936 000 in 2014) that makes the group 8708 the second largest of the 87-groups.

The last group of **8701** was also selected even though its export share represents much less than the previous two groups. The group 8701 – Tractors (other than tractors of heading no 8709), with its USD 56 326 763 000, represents a little bit more than 4%. These data were taken from: http://trademap.org/Index.aspx

3.3. Overview of the Czech Republic

The Czech Republic was created on 1 January 1993, when Czechoslovakia was divided into two independent countries – the Czech Republic and Slovakia. The Czech Republic is bordered by four of its neighbors – Germany (West), Poland (North), Slovakia (East), and Austria (South). The land are of the Czech Republic is approximately 79 thousand square kilometers, and in 2014, the Czech population was estimated at 10.5 million inhabitants. The Czech Republic is a member of the United Nations, World Trade Organization (one of the founding members), the International

Monetary Fund, the Organization for Security and Co-operation in Europe (OSCE), the Organization for Economic Cooperation and Development (OECD), the North Atlantic Treaty Organization (NATO), the European Union, and the Schengen Area. On the other hand the Czech Republic is not a member of the Eurozone, meaning that the Czech Republic uses the Czech crown (CZK).

The Czech political system can be described as a pluralist, multi-party parliamentary democracy. The Prime Minister is the Head of Government. Lower House (or the Chamber of Deputies) is operated through its 200 members that are elected for four years. The Senate (or Upper House) operates through its 81 senators that are elected for six years, with one third of senators replaced every two years. The Czech Republic also has the president who performs primarily representational roles and functions. The president possess some important legal powers, for example, appointing the Prime Minister and members of the government, members of the Czech National Bank Board.

The Czech Republic is a small open export economy. In 2014, about 80% of Czech exports went to, and more than 65% of Czech imports came from, other European Union member state. The Czech Republic exports mainly machinery and transport equipment, raw materials especially to Germany (32%), Slovakia (8.4%), Poland (6%), the United Kingdom (5.1%), France (5.1%), and Austria (4.4%). The total volume of export in 2014 was around USD 174 279.5 mill. The most recent exports are led by cars that represent about 10% of the total exports of the Czech Republic, followed by vehicle parts that account for 7.6%.

Image 1: Czech exports structure in 2013

| Machines | Transportatio | Plastics and... | Foodstuffs | Textile | Mineral Products |
| 36% | 20% | 6.1% | 2.6% | 2.4% | 2.3% |

Source: http://atlas.media.mit.edu/en/profile/country/cze/)
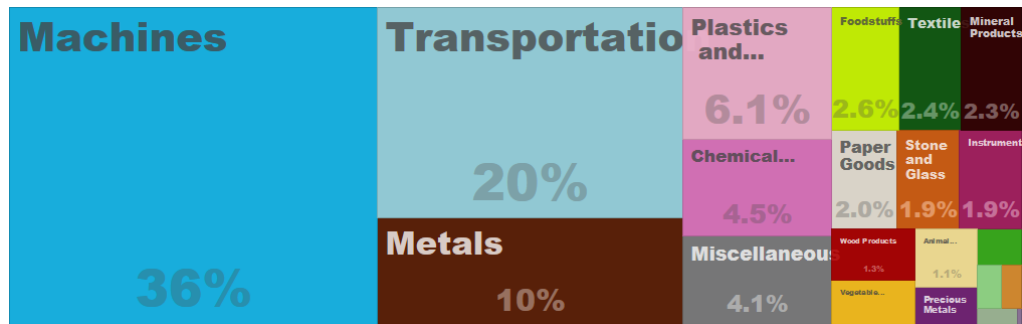
On the other hand, the Czech Republic also imported many commodities in 2014, including machinery and transport equipment, raw materials and fuels and chemicals. The total volume of import in 2014 was about USD 153 225.5 mill. And its main imports partners are: Germany (30.2%), Poland (8.5%), Slovakia (6.8%), China (6.2%), the Netherlands (5.7%), and the Austria (4.2%). The most recent imports are led by vehicle parts which represent around 5.2% of the total imports of the Czech Republic, followed by computers that account for 4.4%.

Image 2: Czech imports structure in 2013
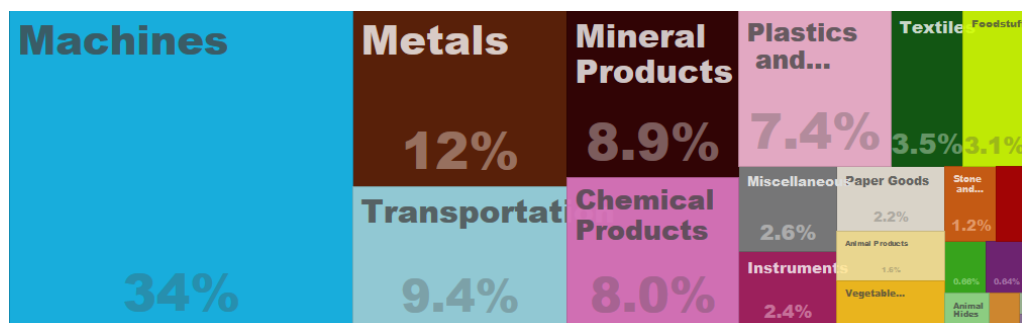
Source: http://atlas.media.mit.edu/en/profile/country/cze/

3.3.1. The key players in the Czech automotive sector

Car makers producing in the CR

Škoda Auto operates thorough its three main production plants in the Czech Republic. The main is located in Mladá Boleslav where they produce models: Škoda Fabia, Octavia, Rapid, and also Seat Toledo. The second plant operates in Kvasiny (Superb and Yeti) and the third factory located in Vrchlabí, specializes in production of transmission. Škoda Auto operates in other countries out of the Czech Republic. The nearest one is in Bratislava, Slovakia (Citigo). The other factories are located in Asia – especially in China with three plans – in Anting (Fabia, Octavia, Yeti), Yizheng (Rapid), and in Ningbo (Octavia and Superb). The car maker aslo operates in Russia with two factories. The first one is in Kaluga (Fabia, Rapid) and the second one is located in Niznij Novgorod (Yeti, Octavia). Finally, there are two more plants placed in India – in Pune (Rapid) and in Aurangabad (Octavia, Superb, Yeti).

Volume: around 1.25 mill. Annually

Models: Fabia, Octavia, Rapid, Superb, Yeti, Seat Toledo

Revenues: CZK 299.3 bill. [1]

Hyundai Motor Manufacturing Czech is a company established in July 2006 and is headquartered from Nizni Lhoty, Czech Republic. Its South Korean owner – Hyundai Motor Company invested more than EUR 1.12 bill. And it still is the first factory ever open in Europe by this company. Hyundai has some other factories in all around the world, such as in South Korea, China, India, the United States, Brazil, and in Russia. The production of cars started in November 2008 in Nosovice – a town closed to Ostrava in Silesia. This factory also specialize on production of transmission for cars. This transmission is then widely exported to the Slovakian factory of KIA and to the Russian factory. Hyundai Motor Manufacturing Czech employs more than 3 500 people mostly from the Czech Republic.

Volume: 300 000

i30, i30 cw, ix20, ix35, Tuscon

Revenues in 2014: CZK 106 bill. [2]

Toyota Peugeot Citroen Automobile (TPCA) is a mutual project between Japanese car maker – Toyota Motor Corporation and French automaker PSA Peugeot Citroen. The biggest car manufacture in the world by volume Toyota Motor Corporation and the European partner signed the agreement of corporation in January 2002. TPCA has invested more than CZK 20 billion, which was the one of the biggest foreign investment in middle Europe. More than 3 000 employees have found a job in a newly-opened factory before it was officially open in February 2005. In the factory, there are produced small cars with low fuel consumption, as these cars are very popular in Europe and around 99% of cars are produced for export.

Volume: around 300 000 cars annually

Cars: Toyota Aygo, Peugeot 108, Citroen C1

Revenues in 2014: CZK 29.8 bill. [3]

3.3.2. CEFTA and common grounds

The Central European Free Trade Agreement unites those countries that are not a part of the European Union but there is a good probability that one day they will be members. In December 1992, the agreement was sign by ministers of foreign affairs of Czechoslovakia, Hungary, and Poland – the Visegrad group countries. It came into force in July 1994. The parties of the agreement hoped in joining the European institutions and agreements as soon as possible. Little bit later – in 1996, Slovenia joined the Central European Free Trade Agreement. Followed by Romania that joined the CEFTA in 1997, two years later Bulgaria joined. In 2003, Croatia joined the agreement. [4]

In 2016, the Central European Free Trade Agreement has seven members, including: Albania, Bosnia and Herzegovina, Macedonia, Moldova, Montenegro, Serbia and the United Nations Interim Administration Mission in Kosovo. All of the countries joined the agreement in 2007, except for Macedonia (2006). Albania, Macedonia, Montenegro and Serbia are official candidate countries of the European Union.

The Czech Republic and Hungary have a very similar history. Both countries were a part of Austro-Hungarian Empire in the 19th and at the beginning of the 20th century. Both countries also have very similar amount of inhabitants – approximately 10 million, while Hungary covers an area about a sixth larger than that of the Czech Republic. When we look at the economic performance of both countries, we found out that the Czech Republic and Hungary have been in the forefront of the Central and Eastern European emerging markets. [5] [8]

The Czech Republic and Hungary were between the first Central and Eastern European countries to sign the Europe Agreements with the Union. In 1995, the agreement with the Czech Republic came into force, and with Hungary even a year before.

In 1995, the Czech Republic joined the Organization for Security and Cooperation in Europe (OSCE), and in 1999, the Czech Republic joined the North Atlantic Treaty Organization – NATO. As mentioned above, the Czech Republic and Hungary are members of the Visegrad group (or Visegrad Four) along with Poland and Slovakia. The grouping aims to promote deeper cooperation among these central European countries to further their integration. The Czech Republic, Slovakia, Poland and Hungary joined the European Union in May 2004, and the Czech Republic holds the rotating presidency of the Visegrad group from July 2015 to June 2016. [4] [5]

3.4.   The overview of Hungary

Hungary is a landlocked country located in Central Europe Budapest is the largest city and capital of Hungary. Hungary has borders with Slovakia (North), Austria and Slovenia (West), Croatia and Serbia (South), and Romania and Ukraine in the east and north-east. In 2014, the population of Hungary is just little bit under ten million inhabitants. The official language is Hungarian. Hungary is a member of the European Union, the North Atlantic Treaty Organization (NATO), the Organization for Economic Co-operation and Development, the Visegrad group (or Visegrad Four), and the Schengen Area as well as a member of the United Nations (1955), World Trade Organization, and the International Monetary Fund. In late October 1989, Hungary became once again a democratic parliamentary republic. Hungary joined the European Union in 2004 but it is not a member of the Eurozone (as well as the Czech Republic). Its currency is the Hungarian Forint (HUF). [8]

The Hungarian unicameral parliament is democratically-elected – called National Assembly. The 199 members of parliament are elected under a combined system of party lists. The president which is elected by the Parliament (unlike in the Czech Republic) every five years, and has a mostly non-political duty. [5]

Image 3: Hungarian exports structure in 2013

Source: http://atlas.media.mit.edu/en/profile/country/hun/
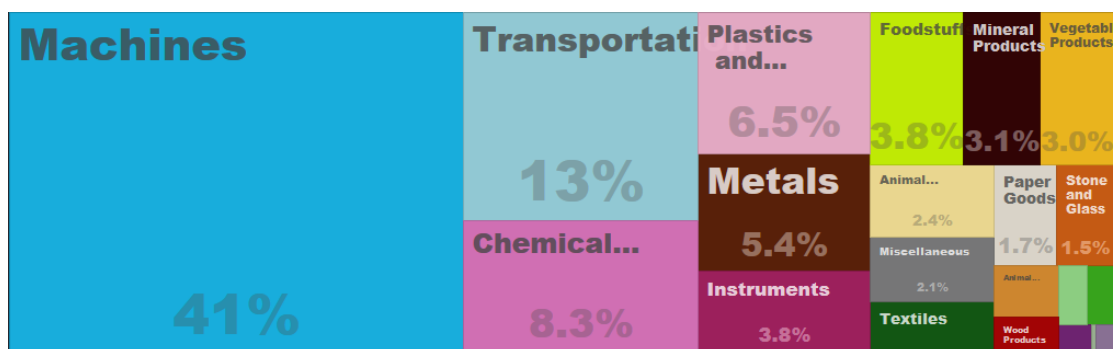
The main export commodities include of machinery and equipment, other manufactures, food products, raw materials, and fuels and electricity. The most recent exports are led by cars which represent about 6.1% of the total Hungarian exports, followed by vehicle parts, which account for approximately 4.5%. The main export partners are as for 2014 usually Germany (28.8%), Austria (5.8%), Romania (5.7%), Slovakia (5.1%), Italy (4.8%), France (4.7%), Poland (4%), and the Czech Republic (4%).

Image 4: Hungarian exports structure in 2013
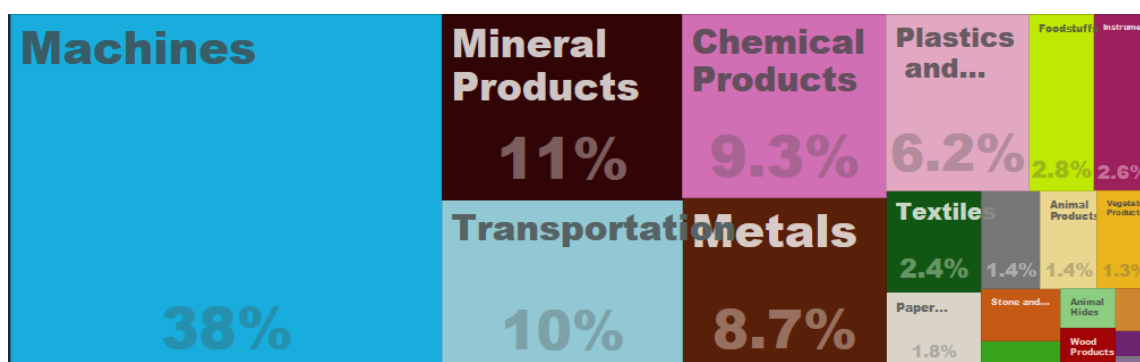
The main import commodities are following: machinery and equipment, other manufactures, fuels and electricity, food products, raw materials. The most recent imports are led by crude petroleum which represents 4.25% of the total imports of Hungary, followed by vehicle parts, which account for 4.1%. The main import partners in 2014 are following: Germany (25.6%), Austria (7.4%), Russia (7%), China (6.2%), Slovakia (5.5%), Poland (5.3%), France (4.8%), the Czech Republic (4.6%), Italy (4.5%), and the Netherlands (4.1%).

3.3.1. The key players in Hungary

Magyar Suzuki Corporation is a car factory founded in 1991 and located in Esztergom, Hungary. The first car – first generation of Swift - was manufactured in 1992. Current production capacity is about 300 000 units annually. The initial investment was around HUF 14 bill. and more than 6 300 employees found a job in factory.

Volume: 300 000 annually

Models: Fiat Sedici, Opel Agila, Suzuki Cultus, Swift, Suzuki SX4, Suzuki Splash, Suzuki SX4 S-Cross, Suzuki Vitara

Mercedes-Benz Manufacturing Hungary is an automotive manufacturing plant located in Kecskemet, Hungary about 100 kilometers form Budapest. The plant officially started with the production in 2012 by producing brand new Mercedes CLA and Mercedes B type. The initial investment covered more than EUR 1 bill. The Hungarian plant of Mercedes had over 4 000 employees as of 2014.

Volume: 300 000

Models: Mercedes CLA, Mercedes B [6]

Audi Hungaria Motor is a factory located in Gyor, Hungary. It was established in 1993 and the first engine was produced in 1994. Now, the plant produces a large scale of various engines models from V4 – V12 and operates through its more than 10 000 employees. In 2013, the plant started a serial production of cars – Audi A3, S3, and TT. As Audi is a part of Volkswagen group, the factory Audi Hungaria also produces engines for other brands – Lamborghini and Porsche. The total amount of investment is around EUR 6.7 bill.

Volume: more than 40 000 cars and around 2 million of engines

Models: Audi A3, Audi S3 [7]

4. Methodology

4.1.   Balassa index

Balassa index is the first index to be used in the practical part. This index uses only export data of a given country. By Balassa index, this research measures revealed comparative advantage (RCA). A big advantage of Balassa index is that it can calculate RCA of a single country in a global scale, or with comparison with another country, or with comparison of a set of countries. This research uses Balassa index for all these three options. (Balassa, 1965)

Firstly, this research measures the RCA of the Czech Republic and Hungary from global point of view (Czech Republic over the world, Hungary over the world).

Secondly, there is measured the RCA of the Czech Republic over Hungary.

Thirdly, this research measures the RCA of the Czech Republic and Hungary over the Visegrad group.

Balassa index is calculated from this formula:

$$\textbf{RCA} = (\textbf{X}_{ij} / \textbf{X}_{it})/(\textbf{X}_{nj} / \textbf{X}_{nt})$$

where X is exports, i – a country, j – a commodity, n – a set of countries (or another country), t – a set of commodities.

RCA is based on export performance and observed trade patterns. At measures a country's exports of a commodity relative to its total exports. Thus if RCA>1, then a comparative advantage is revealed, and if RCA<1, then a comparative disadvantage is revealed. There cannot be any negative results unlike for Vollrath and Lafay, where the RCA is revealed when RCA>0. Thus if RCA<0, then a comparative disadvantage is revealed. (Balassa, 1965)

4.2. Vollrath index

The Vollrath index is a bit more complex than the Balassa index, while it uses not only export data but also import data. Vollrath has developed an index, which allows to assess trade flows as for export values, and as taking into account values of import. (Vollrath, 1991) Vollrath argued that revealed competitiveness (in this case revealed competitiveness – RC; not Balassa´s RCA) is more suitable since supply and demand balances are included in the index. The revealed competitiveness can be calculated as the difference between the original Balassa´s revealed comparative advantage, but in case of Vollrath, this was called relative export advantage (RXA), and its opposite – relative import advantage (RMA).

That means, if Vollrath´s relative export advantage is the same as the original Balassa index, there is no need for a new calculation of RXA because we already have it calculated as Balassa´s RCA.

RXA = (X_{ij} / X_{it})/(X_{nj} / X_{nt}),

RMA = (M_{ij} / M_{it})/(M_{nj} / M_{nt}),

where X – are imports, M – are import, i – a country, j – a commodity, n – a set of countries, t – a set of commodities.

The Vollrath index is formulated as:

RC = lnRXA – lnRMA

There is a big difference in expression of the results in comparison with the Balassa index. Balassa index result is expressed as, if RCA>1, then a comparative advantage is revealed. If RCA<1, then a comparative disadvantage is revealed.

In case of the Vollrath index, **positive results** of the Vollrath index **reveal competitiveness,** and negative values show competitive disadvantage. Balassa and

Vollrath approaches rely on different concepts and that is why they are not strictly comparable. (Utkulu, 2004) (Vollrath, 1991)

4.3. Lafay index

Lafay index (LFI) of international specialization analyze comparative advantage or disadvantage of a country in a specific good (or subsector, sector) in comparison of the trade balance of the specific good, with total trade balance of the country. While taking into account rate of exchange of the specific good in the total turnover of the total trade.

The Lafay index does not measure comparative advantage in comparison with other country (or a set of countries). It measures comparative advantage in comparison to the total structure of trade of a given country. Positive values of LFI show comparative advantage of a given product in the total structure of trade of a given country. That means that there will not be that many rows in the final tables because we will measure only comparative advantage (or disadvantage) of a given product within the total structure of trade of a given country. In other word, the LFI combines together trade and production variables. Using this index we consider the difference between each item's normalized trade balance and total normalized trade balance. (Lafay, 1992)

For a given country, *i*, and for any given product *j*, the Lafay index is formulated as:

$$LFI_j^i = 100\left(\frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_{j=1}^{N}(x_j^i - m_j^i)}{\sum_{j=1}^{N}(x_j^i + m_j^i)}\right)\frac{x_j^i + m_j^i}{\sum_{j=1}^{N}(x_j^i + m_j^i)}$$

5. Practical part: Index analyses

5.1.   Analysis of total export and import of the Czech Republic and Hungary

Export and Import data 2001 - 2014

Table 1: Total export data (in ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	33 384 210	44 263 576	48 720 350	65 771 587	78 208 548	95 140 986	120 900 492
Hungary	30 497 719	34 336 583	43 003 656	55 468 212	62 271 839	74 055 406	94 590 870
V4	111 884 993	133 331 478	166 396 472	222 882 761	261 710 590	320 466 752	412 312 348
World	6 114 505 660	6 403 660 225	7 463 286 864	9 086 813 784	10 342 460 927	11 952 387 109	13 772 780 256

	2008	2009	2010	2011	2012	2013	2014
CR	146 087 029	112 884 321	132 140 914	162 391 721	156 422 743	161 524 152	174 279 452
Hungary	108 211 166	82 571 847	94 748 737	111 216 834	103 006 014	107 729 976	112 196 295
V4	496 346 790	387 650 495	447 953 212	540 200 888	518 899 352	558 286 204	586 928 830
World	15 972 312 416	12 314 697 361	15 057 105 841	18 066 514 928	18 202 308 765	18 684 466 211	18 686 070 183

Source: Own production, data taken from http://trademap.org/Index.aspx

In this total exports data table we can see development of total exports of focused units – the Czech Republic, Hungary, Visegrad group, and the world. We can see that the Czech Republic and Hungary were in very similar position at the beginning of the research. The Czech Republic had just under USD 3 bill advantage over Hungary in 2001 (note how exports of the Czech Republic increased rapidly in the next year – over USD 10.5 bill, and we see that share of these two countries is more than 55% within the Visegrad group in 2001. The year 2011 was the last year, where the sum of Czech and Hungarian exports represented more than 50% because in 2012, the share of Czech and Hungarian exports was calculated as 49.996%. It can be stated that from 2012, the Czech Republic and Hungary have lost their very dominant position within the Visegrad group, and Poland with Slovakia started to catch up quickly. The highest year growth of exports was for the Czech Republic between 2003-2004, when it was around 35% and the second highest growth was detected between 2001 and 2002, with

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33%. For Hungary, the highest exported growth was detected between 2003 and 2004 (29%), and the second highest between 2006 and 2007, when it was around 28%.

Another interesting fact is the drop in 2009 when the world financial crisis came from the United States and hit Europe hard for many years. By my calculations using these numbers, the drop in the world exports was around -23%, for the Czech Republic it was the same -23% , and for Hungary even one percentage point higher (-24%). In the graph below, we see the development of Czech and Hungarian exports. At the beginning of the research – in 2001, both of the countries started from almost the same starting point and then we see how Czech exports rises a bit more than the Hungarian one. So the Czech export rises a bit more but the Hungarian kind of copies the same shape as the Czech total export. The Hungarian export losses a bit more every year of the research but the shape of the graph stays almost the same. There was registered one more drop in total exports – from 2011 to 2012. In case of Czech exports it was -4% and for Hungary it was around -7%. Fortunately this was just a little drop in comparison with the year of 2009.

Graph 1: Czech and Hungarian total exports development 2001-2014 (ths. USD)

Source: Own production, data taken from http://trademap.org/Index.aspx

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Table 2: Total import data (in ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	36 476 654	48 230 794	51 239 343	66 705 682	76 527 310	93 429 474	116 822 197
Hungary	33 681 734	37 611 572	47 674 542	60 248 602	65 919 579	76 978 511	94 659 727
V4	134 375 504	156 736 444	188 660 763	244 565 357	278 211 527	340 811 915	434 862 199
World	6 324 509 730	6 586 827 695	7 682 853 525	9 382 060 863	10 607 834 908	12 245 802 740	14 095 906 118

	2008	2009	2010	2011	2012	2013	2014
CR	141 833 836	104 849 536	125 690 658	150 813 416	139 726 824	142 525 808	153 225 461
Hungary	108 784 724	77 272 443	87 432 095	101 369 997	94 266 239	98 661 803	103 110 997
V4	533 708 631	386 851 760	451 632 314	538 065 223	502 282 527	528 096 513	554 377 917
World	16 352 222 166	12 603 159 274	15 254 895 075	18 238 694 336	18 329 977 181	18 705 114 822	18 729 446 763

Source: Own production, data taken from http://trademap.org/Index.aspx

In this table, we can notice that imports of both countries, and even the whole Visegrad group, are higher than exports. Meaning that we could consider both countries and the Visegrad group more as importers than exporters. But if we have a closer look at the graph below, we can notice that for many years now, we considers both countries more as exporters than importers. In the case of the Czech Republic, it has been the year of 2005, where it can be stated that the Czech Republic has higher exports than imports, and a good news is that exports increase more than import every year. In the case of Hungary, the breaking point year was the financial crisis year of 2009. From this year, we can consider Hungary more as an exporter than importer. When we consider, that in 2001, the import of the Czech Republic was higher by around USD 2.8 bill, and in 2014 the Czech Republic with its imports over USD 153 bill, in comparison with Hungary and its imports a bit over USD 103 bill – it could be stated that the import of the Czech Republic rises annually more than in Hungary.

The highest imported growth in value for the Czech Republic was in 2001-2002, when it raised by 32%, and another one between 2003 and 2004, when the growth raised by 30%. The world financial crisis influenced the year 2009, when the drop in comparison with the year 2008 was around -26%

For Hungary, the highest imported growth in value was in 2002-2003 with the growth about 27%, and the second highest growth was detected in 2003-2004 with 26%. In 2008-2009, there was a drop in Hungarian total import by -29%.

Graph 2: Development of Czech and Hungarian export and import 2001-2014 (ths. USD)

Source: Own production, data taken from http://trademap.org/Index.aspx
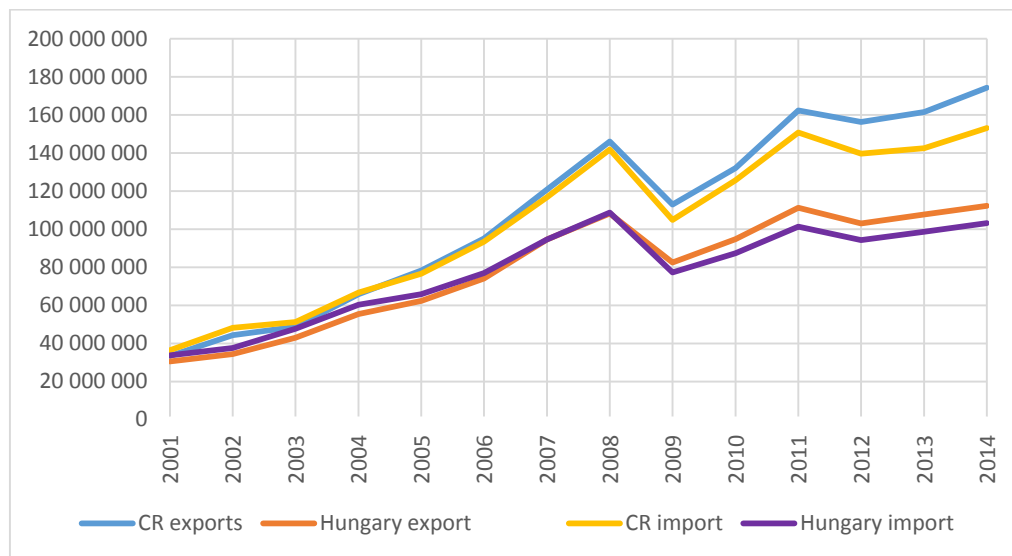
5.2.   Balassa index calculation

Balassa index calculation

Balassa index is the first index to be used in this practical part. This index uses only export data of selected countries. By Balassa index, this research measures revealed comparative advantage (RCA) (Balassa, 1965). A big advantage is of Balassa index is that it can be calculated RCA of a single country in a global scale, or with comparison with another country, or with comparison of selected region. This research uses the Balassa index for all these three options.

Firstly, this research will measure the RCA of the Czech Republic and Hungary in a global scale (point of view).

Secondly, there will be measured the RCA of the Czech Republic over Hungary.

Thirdly, this research will measure the RCA of the Czech Republic and Hungary within the Visegrad group.

This research focuses on the Czech and Hungarian automotive sector and that is why we start with the automotive sector as itself before we move to its subsectors. So the dominant sector is called:

87 – Vehicles other than railway, tramway

With four different subsectors:

8701 – Tractors (other than tractors of heading no 8709)

8702 – Public-transport type passenger motor vehicles

8703 – Cars (incl. station wagon)

8708 – Parts and access of motor vehicles

The group number **8703** – Cars accounts with its USD 701 037 129 000 for more than 50.7% of global export within the whole group of 87 – Vehicles other than railways with its USD 1 381 625 672 000 (in this case representing 100%) in 2014.

The second choice naturally went for the group number **8708** – Parts and access of motor vehicles with their export share of almost 27% (USD 371 935 936 000 in 2014) that makes the group 8708 the second largest of the 87-groups.

The last group of **8701** was also selected even though its export share represents much less than the previous two groups. The group 8701 – Tractors (other than tractors of heading no 8709), with its USD 56 326 763 000, represents a little bit more than 4%.

As mentioned above, the Balassa index uses only export data, that's why below, there is attached a table that shows export data of the Czech Republic, Hungary, the Visegrad group, and the world. But that would not be enough to calculated, and that's why we need to know total export data of the countries and group of the countries which is listed above. The index is calculated as follows:

$$\mathbf{RCA = (X_{ij} / X_{it})/(X_{nj} / X_{nt})}$$

where X is exports, i – a country, j – a commodity, n – a set of countries (or another country), t – a set of commodities.

RCA is based on export performance and observed trade patterns. At measures a country's exports of a commodity relative to its total exports. Thus if RCA>1, then a comparative advantage is revealed, and if RCA<1, then a comparative disadvantage is revealed. There cannot be any negative results unlike for Vollrath and Lafay, where the RCA is revealed when RCA>0. Thus if RCA<0, then a comparative disadvantage is revealed. (Balassa, 1965)

Balassa index calculation

Table 3: Export data of the group 87 (in ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	5 334 871	8 038 881	7 457 204	9 940 575	12 804 246	16 132 165	20 336 387
Hungary	2 716 046	2 984 815	3 526 725	4 402 909	5 376 165	7 248 728	10 390 335
V4	13 671 167	17 710 593	22 372 300	29 953 014	35 639 009	46 618 425	63 102 728
World	554 669 958	614 451 017	711 349 088	838 648 987	912 376 879	1 007 963 152	1 182 991 622

	2008	2009	2010	2011	2012	2013	2014
CR	23 226 774	19 575 454	22 732 961	27 823 701	27 177 786	28 857 732	33 152 488
Hungary	12 370 806	7 583 324	8 878 641	10 464 760	10 261 439	13 473 898	17 810 931
V4	75 852 791	58 394 562	65 393 262	79 049 303	76 763 162	85 259 691	94 922 897
World	1 239 400 208	847 123 316	1 084 874 170	1 272 811 929	1 296 513 102	1 343 434 315	1 381 625 672

Source: Own production, data taken from http://trademap.org/Index.aspx

Table 4: Total export data (in ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	33 384 210	44 263 576	48 720 350	65 771 587	78 208 548	95 140 986	120 900 492
Hungary	30 497 719	34 336 583	43 003 656	55 468 212	62 271 839	74 055 406	94 590 870
V4	111 884 993	133 331 478	166 396 472	222 882 761	261 710 590	320 466 752	412 312 348
World	6 114 505 660	6 403 660 225	7 463 286 864	9 086 813 784	10 342 460 927	11 952 387 109	13 772 780 256

	2008	2009	2010	2011	2012	2013	2014
CR	146 087 029	112 884 321	132 140 914	162 391 721	156 422 743	161 524 152	174 279 452
Hungary	108 211 166	82 571 847	94 748 737	111 216 834	103 006 014	107 729 976	112 196 295
V4	496 346 790	387 650 495	447 953 212	540 200 888	518 899 352	558 286 204	586 928 830
World	15 972 312 416	12 314 697 361	15 057 105 841	18 066 514 928	18 202 308 765	18 684 466 211	18 686 070 183

Source: Own production, data taken from http://trademap.org/Index.aspx

$$RCA = (X_{ij} / X_{it})/(X_{nj} / X_{nt})$$

where X is exports, i – a country, j – a commodity, n – a set of countries (or another country), t – a set of commodities.

When all these data is available, then we can start computing RCA of the Czech Republic in the global point of view for 2001. Note that all of the numbers are in thousands of USD and that is why this research uses the same values as are mentioned in the tables. For calculation of the first bracket (X_{ij} / X_{it}), we need to know:

1) a selected country´s export of a given product – in our case it is the whole sector 87 exported by the Czech Republic in 2001 - **5 334 871**

2) the selected country´ total export (all products) – in our case, this number represents the total export of the Czech Republic in 2001 - **33 384 210**

As mentioned above, there is calculated the RCA of the Czech Republic in the global point of view for 2001, and that's why there is used the global (world´s) figures. So for calculation of the second bracket **(X_{nj} / X_{nt})**, we need to know:

3) a set of countries´ export of a given product – in our case, that's the world export of the whole sector 87 in 2001 – **554 669 958**
4) a set of countries´ total export (all products) – in this case, that's global total export in 2001 - **6 114 505 660**

Finally, now we possess all wanted figures for calculation the revealed comparative of the Czech Republic in a global point of view.

RCA = (Xij / Xit)/(Xnj / Xnt)

BI (CZE/WORLD) 2001 = (5 334 871 / 33 384 210) / (554 669 958 / 6 114 505 660) = 1.762

RCA is based on export performance and observed trade patterns. At measures a country's exports of a commodity relative to its total exports. Thus if **RCA>1**, then **a comparative advantage** is revealed, and if RCA<1, then a comparative disadvantage is revealed. (Balassa, 1965)

On the basis of this index, the Czech Republic is defined as being specialized in exports of the group number 87 – Vehicles other than railway, tramway because its market share in that product is higher than the average or, if the weight of the group 87 – Vehicles other than railway, tramway of the Czech Republic´s exports is higher than its weight of the exports of the reference area (in this case – the whole world). In

a simplified way, it can be stated that in 2001, the Czech Republic exported 1.762 times its so called fair share of the commodity export.

According to previous explanation of calculating the Balassa index, the research continues with the same calculation for different years (and with different numbers obviously). When the calculation of the RCA of the Czech Republic for years 2001-2014 is complete, we move to Hungary. The research follows the same instructions as for previous calculation:

For the first bracket (X_{ij} / X_{it}), it´s necessary to know the Hungarian export of the group 87- Vehicles other than railway, tramway in 2001 (**2 716 046**), and the Hungarian total export (**30 497 719**).

For the second bracket (X_{nj} / X_{nt}), we need to know the global export of the group 87 (**554 669 958**), and the global total export (**6 114 505 660**).

RCA = (Xij / Xit)/(Xnj / Xnt)

BI (HUN/WORLD) 2001 = (2 716 046 / 30 497 719) / (554 669 958 / 6 114 505 660) = 0.982

The Hungarian automotive sector revealed comparative disadvantage since 0.982 is lower than one. This result shows, how close sometimes is the line between the revealed comparative advantage and the revealed comparative disadvantage.

The research follows the same instructions even for the point of view of the Czech Republic over Hungary. With exception that in the first bracket, we put the Czech Republic, and in the second bracket we put Hungary.

BI (CZE/HUN) 2001 = (5 334 871 / 33 384 210) / (2 716 046 / 30 497 719) = 1.794

The expression of this figure (1.794) is following: **The Czech Republic possess RCA in comparison with Hungary**.

Example: If we switch the brackets of the formula, the Balassa index will be from point of view of Hungary and it will show revealed comparative **disadvantage of Hungary over the Czech Republic**.

BI (HUN/ CZE) 2001 = (2 716 046 / 30 497 719) / (5 334 871 / 33 384 210) = 0.557

And finally, the research is able to calculate RCA of both countries over (in comparison with) the Visegrad group. Both countries will be place in the first bracket and in the second, there will be the Visegrad group.

BI (CZE/V4) 2001 = (5 334 871 / 33 384 210) / (13 671 167 / 111 884 993) = 1.308

BI (HUN/ V4) 2001 = (2 716 046 / 30 497 719) / (13 671 167 / 111 884 993) = 0.729

5.2.1. Analysis of Balassa index for the 87-group

Table 5: Balassa index for the group 87-Vehicles other than railway, tramway

	2001	2002	2003	2004	2005	2006	2007
CR/World	1,762	1,893	1,606	1,638	1,856	2,011	1,958
HUN/World	0,982	0,906	0,860	0,860	0,979	1,161	1,279
CR/HUN	1,794	2,089	1,866	1,904	1,896	1,732	1,531
CR/V4	1,308	1,367	1,138	1,125	1,202	1,166	1,099
HUN/V4	0,729	0,654	0,610	0,591	0,634	0,673	0,718

	2008	2009	2010	2011	2012	2013	2014
CR/World	2,049	2,521	2,388	2,432	2,439	2,485	2,573
HUN/World	1,473	1,335	1,301	1,336	1,399	1,739	2,147
CR/HUN	1,391	1,888	1,836	1,821	1,744	1,428	1,198
CR/V4	1,040	1,151	1,178	1,171	1,174	1,170	1,176
HUN/V4	0,748	0,610	0,642	0,643	0,673	0,819	0,982

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Note: Green color indicates presence of RCA

Graph 3: Balassa index for the group 87-Vehicles other than railway, tramway
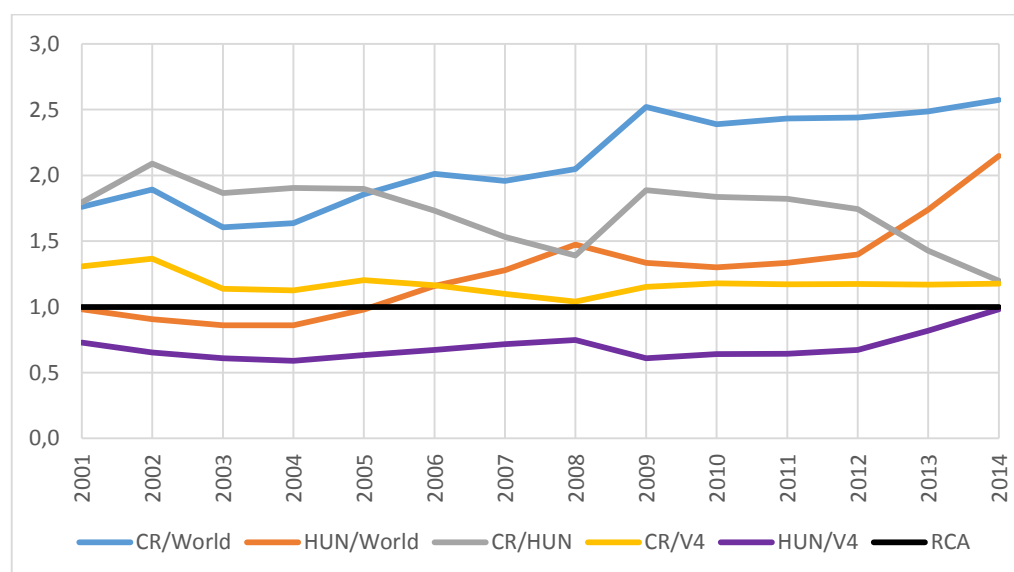
Source: Own production, based on data from http://trademap.org/Index.aspx

The research follows previous instruction and the Table 5 was constructed for all the years needed 2001-2014. Note that according Balassa, RCA is based on export performance and observed trade patterns. At measures a country's exports of a commodity relative to its total exports. Thus if RCA>1, then a comparative advantage is revealed, and if RCA<1, then a comparative disadvantage is revealed. That is why in the table above some values are colored by green color for better recognition of RCA>1. In the graph, bellow there are the same values from the table above, only illustrated graphically. The black thick line is a constant that indicates where the line between revealed comparative advantage and revealed comparative disadvantage is.

Analysis of Balassa index for the group 87-Vehicles

With a closer look at the Table 5 or the Graph 3, it´s obvious that the performance of the Czech Republic´s export of the group 87 is in green digits which indicate revealed comparative advantage. RCA of the Czech Republic over the world is slightly increasing every year except a couple of years. In 2008, there was overcome the magical border of two, which indicates that since 2008, the Czech Republic has exported more than 2 times its so called fair share of the commodity export. An interesting fact is, that RCA of the Czech Republic over the world is every year much higher than RCA of the Czech Republic over the Visegrad group (V4). The explanation for this result is the fact, that the region of the Central Europe is very developed and active in term of exports within the group 87 – Vehicles other than railway, tramway, in comparison with the rest of the world. The good example of this phenomena is the row of RCA of Hungary over V4, where we see no green color indicating the RCA in any of the fourteen years (however, in 2014, Hungary is very close). But the row of Hungary over the world, we see that Hungary overcame the border of RCA in 2006. In 2014, Hungary exported more than 2 times of its so called fair share of the commodity export in a global point of view. Hungary is catching up the Czech Republic rapidly in last a couple of years, and there might be just a question of time, when Hungary will catch up, and one of the reason is that if both countries export similar amount of the group 87, Hungary will in some time possess RCA over the Czech Republic because Hungary has lower total export.

5.2.2. Analysis of Balassa index for the 8703 subgroup

Table 6: Export data of the subgroup 8703 (in ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	2 921 265	4 815 258	3 488 865	4 592 023	6 313 166	8 429 659	10 062 434
Hungary	1 466 579	1 481 168	1 513 335	1 837 554	2 221 874	3 292 610	5 786 675
V4	7 563 892	9 844 759	11 273 140	14 850 945	17 737 033	25 038 493	33 735 586
World	308 879 731	343 980 175	393 151 878	455 122 971	487 083 729	535 949 517	623 929 846

	2008	2009	2010	2011	2012	2013	2014
CR	10 863 019	10 596 240	12 489 973	15 512 077	15 197 220	15 345 240	17 811 636
Hungary	6 760 917	3 932 818	4 146 002	4 898 437	5 093 635	7 399 122	11 031 183
V4	38 469 796	31 818 220	34 526 213	41 676 900	40 300 149	44 092 159	50 280 701
World	636 796 500	435 443 393	556 215 423	637 319 425	645 766 656	673 047 456	701 037 129

Source: Own production, data taken from http://trademap.org/Index.aspx

For the calculation of Balassa index for 8703 – Cars subgroup, it´s essential to know the export of this product for selected countries and group of countries which is given in the table above (Table 6). The second thing, it necessary to know is the total export of these units, and that is listed in the previous chapter. Following the same instruction as in the previous chapter, the research prepared following table and graph for Balassa index for 8703 – Cars (8703) subgroup. As mentioned in the previous chapter, there is the green color which indicates occurrence of revealed comparative advantage, and the white color indicates absence of RCA. In the graphical illustration, there is the black thick line which indicates the same occurrence as the green color in the table.

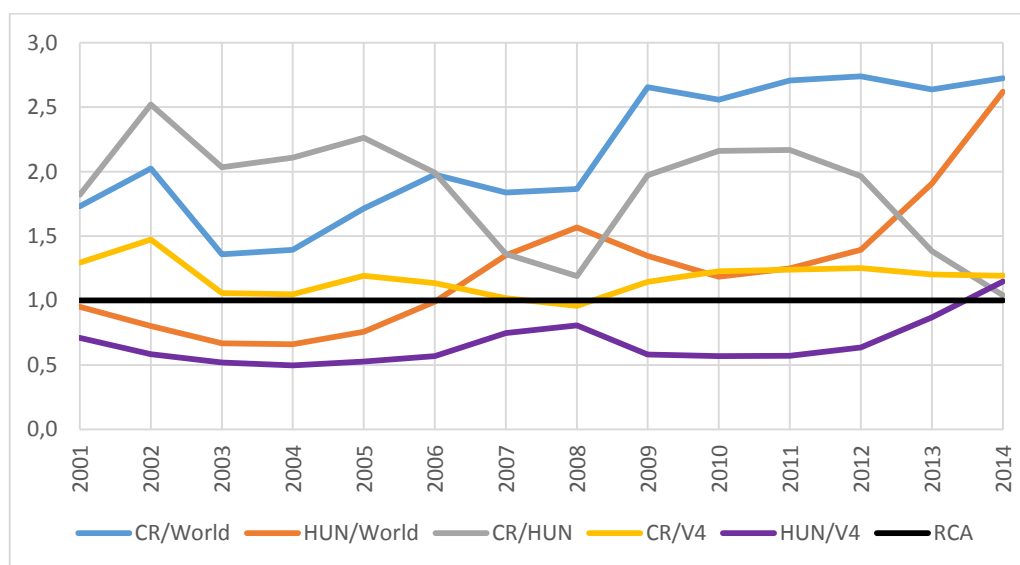**Table 7: Balassa index for subgroup 8703-Cars (incl. station wagon)**

	2001	2002	2003	2004	2005	2006	2007
CR/World	1,732	2,025	1,359	1,394	1,714	1,976	1,837
HUN/World	0,952	0,803	0,668	0,661	0,758	0,992	1,350
CR/HUN	1,820	2,522	2,035	2,108	2,262	1,993	1,360
CR/V4	1,294	1,473	1,057	1,048	1,191	1,134	1,017
HUN/V4	0,711	0,584	0,519	0,497	0,526	0,569	0,748

	2008	2009	2010	2011	2012	2013	2014
CR/World	1,865	2,655	2,559	2,708	2,739	2,637	2,724
HUN/World	1,567	1,347	1,185	1,249	1,394	1,907	2,621
CR/HUN	1,190	1,971	2,160	2,169	1,965	1,383	1,039
CR/V4	0,959	1,144	1,226	1,238	1,251	1,203	1,193
HUN/V4	0,806	0,580	0,568	0,571	0,637	0,870	1,148

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Note: Green color indicates presence of RCA

Graph 4: Balassa index for subgroup 8703-Cars (incl. station wagon)

Source: Own production, based on data from http://trademap.org/Index.aspx

Analysis of Balassa index for subgroup 8703-Cars

This table and graph show very similar results as for the whole group 87. The reason for this is the fact, that 8703 subgroup is the largest subgroups of all in the group 87. It represents in almost every year more than 50% for enlisted countries and groups of countries. The Czech Republic shows its dominance again in every comparison and point of view, except one little exception in 2008, when it possess

revealed comparative disadvantage over the Visegrad group. Hungary possess revealed comparative disadvantage over the world between the years 2001 - 2006 as for the 87 group (2001-2005) mentioned in the previous chapter. Hungary was in disadvantage over the Visegrad group in almost every year in this observation, when finally, Hungary came to have RCA in the last year of this observation (2014) over the V4.

5.2.3. Analysis of Balassa index for the 8708 subgroup

Table 8: Export data of the subgroup 8708 (in ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	1 939 291	2 708 158	3 401 700	4 529 481	5 396 907	6 312 726	8 146 485
Hungary	892 108	1 152 913	1 593 352	1 961 451	2 304 183	2 891 178	3 556 939
V4	4 325 836	5 878 137	8 371 669	10 746 938	12 372 508	14 987 694	20 142 056
World	132 748 310	147 988 273	172 782 675	205 685 650	225 747 107	248 690 278	284 164 315

	2008	2009	2010	2011	2012	2013	2014
CR	9 573 396	7 409 185	8 530 155	10 571 578	10 147 817	11 564 263	13 176 052
Hungary	3 690 338	2 660 385	3 380 935	4 217 499	3 855 282	4 576 025	5 301 671
V4	23 762 778	18 517 074	22 108 492	26 818 721	25 280 807	29 350 715	32 958 498
World	295 975 678	219 230 891	290 600 413	341 542 610	344 826 248	362 394 472	371 935 936

Source: Own production, data taken from http://trademap.org/Index.aspx

Table 9: Balassa index for subgroup 8708 – Parts & access of motor vehicles

	2001	2002	2003	2004	2005	2006	2007
CR/World	2,676	2,647	3,016	3,042	3,161	3,189	3,266
HUN/World	1,347	1,453	1,600	1,562	1,695	1,876	1,823
CR/HUN	1,986	1,822	1,884	1,947	1,865	1,700	1,792
CR/V4	1,502	1,388	1,388	1,428	1,460	1,419	1,379
HUN/V4	0,757	0,762	0,736	0,733	0,783	0,835	0,770

	2008	2009	2010	2011	2012	2013	2014
CR/World	3,536	3,687	3,345	3,444	3,425	3,691	3,798
HUN/World	1,840	1,810	1,849	2,006	1,976	2,190	2,374
CR/HUN	1,922	2,037	1,809	1,717	1,733	1,685	1,600
CR/V4	1,369	1,374	1,308	1,311	1,332	1,362	1,346
HUN/V4	0,712	0,674	0,723	0,764	0,768	0,808	0,841

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Note: Green color indicates presence of RCA

Graph 5: Balassa index for subgroup 8708 – Parts & access of motor vehicles
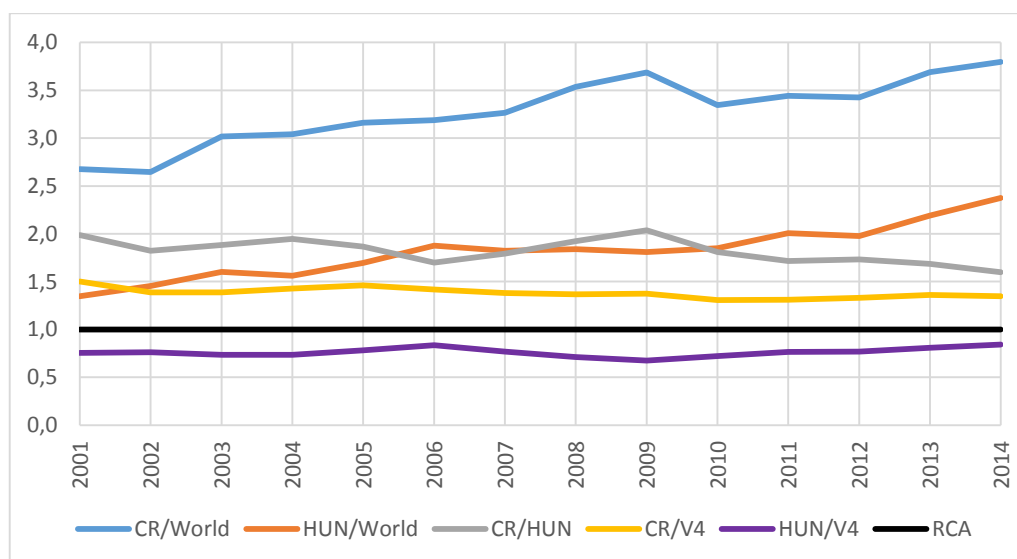
Source: Own production, based on data from http://trademap.org/Index.aspx

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Analysis of Balassa index for subgroup 8708 – Parts

The Czech Republic over the world indicates the greatest RCA in comparison with other subjects of measuring. RCA of the Czech Republic over the world is slightly increasing every year, except for the year 2010 which is influenced by the world financial crisis that took place mostly in 2008 – 2009. From the year 2004, it can be stated that the Czech Republic has exported more than 3 times its so called fair share of the commodity export. The Czech Republic over the Visegrad group line is very stable just under the BI 1.5 that shows the RCA, and the Czech Republic has over Hungary the RCA as well, but this figure is from 2009 still decreasing which shows us higher competitiveness of Hungary in the last years.

The only line in the graph showing the revealed comparative disadvantage is Hungary over the Visegrad group. The line is very stable and shows how close it is below the RCA line.

5.2.4. Analysis of Balassa index for the 8701 subgroup

Table 10: Export data of the subgroup 8701 (in ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	54 573	65 949	93 555	125 366	183 026	235 890	305 067
Hungary	6 694	9 177	11 052	24 011	23 389	45 060	74 163
V4	130 995	143 819	167 057	234 239	345 428	565 409	872 978
World	16 248 865	19 298 769	23 636 730	31 772 599	34 714 895	39 251 419	47 292 203

	2008	2009	2010	2011	2012	2013	2014
CR	348 262	204 526	205 094	274 332	312 115	317 967	313 253
Hungary	116 692	57 756	97 207	115 552	111 665	104 104	90 604
V4	1 443 633	755 003	854 141	1 234 403	1 251 259	1 311 060	1 236 940
World	57 072 395	28 951 153	36 816 345	54 295 163	54 519 177	54 410 928	56 326 763

Source: Own production, data taken from http://trademap.org/Index.aspx

For the calculation of Balassa index for the 8701 subgroup, we again will need to know the export of this product for selected countries and groups of countries that is given in the Table 10. The second thing, it necessary to know is the total export of these units, and that is in the Table 4.

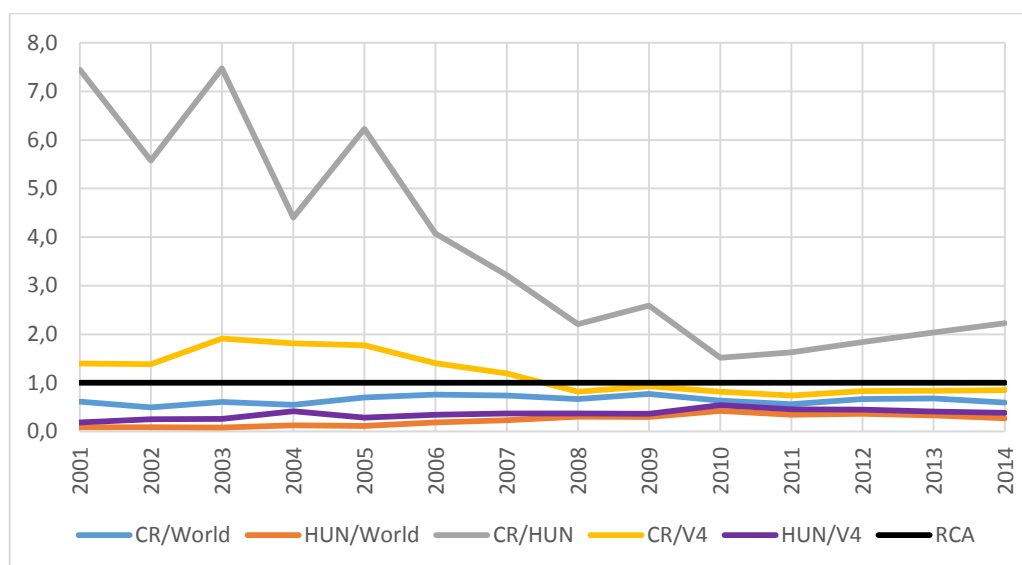**Table 11: Balassa index for subgroup 8701 – Tractors (other than Tractors 8709)**

	2001	2002	2003	2004	2005	2006	2007
CR/World	0,615	0,494	0,606	0,545	0,697	0,755	0,735
HUN/World	0,083	0,089	0,081	0,124	0,112	0,185	0,228
CR/HUN	7,448	5,575	7,472	4,403	6,231	4,075	3,218
CR/V4	1,396	1,381	1,913	1,814	1,773	1,405	1,192
HUN/V4	0,187	0,248	0,256	0,412	0,285	0,345	0,370

	2008	2009	2010	2011	2012	2013	2014
CR/World	0,667	0,771	0,635	0,562	0,666	0,676	0,596
HUN/World	0,302	0,298	0,420	0,346	0,362	0,332	0,268
CR/HUN	2,211	2,590	1,513	1,626	1,841	2,037	2,226
CR/V4	0,820	0,930	0,814	0,739	0,827	0,838	0,853
HUN/V4	0,371	0,359	0,538	0,455	0,450	0,411	0,383

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx
Note: Green color indicates presence of RCA

Graph 6: Balassa index for subgroup 8701 – Tractors (other than Tractors 8709)

Analysis Balassa index for subgroup 8701 – Tractors

The subgroup 8701 represents tractors (other than tractors of heading no 8709). This is the first table which shows mostly revealed comparative disadvantage for most of the units. The only line of the Czech Republic over Hungary shows the RCA during all fourteen observations. With its record values in 2001 and 2003, where the RCA is over seven. The other positive subject until 2007 is the Czech Republic over the V4 with its record detected in 2003. Between the years 2008 – 2014, the figures are just under the RCA line.

On the other hand, Hungary over the world shows the lowest figures, and just little bit better does Hungary over the V4

5.3. Vollrath index calculation

Vollrath index calculation

The Vollrath index is a bit more complex than the Balassa index, while it uses not only export data but also import data. Vollrath has developed an index, which allows to assess trade flows as for export values, and as taking into account values of import. Vollrath argued that revealed competitiveness (in this case revealed competitiveness – RC; not Balassa´s RCA) is more suitable since supply and demand balances are included in the index. The revealed competitiveness can be calculated as the difference between the original Balassa´s revealed comparative advantage, but in case of Vollrath, this was called relative export advantage (RXA), and its opposite – relative import advantage (RMA).

That means, if Vollrath´s relative export advantage is the same as the original Balassa index, there is no need for a new calculation of RXA because we already have it calculated as Balassa´s RCA.

$$\textbf{RXA} = (\textbf{X}_{ij} / \textbf{X}_{it}) / (\textbf{X}_{nj} / \textbf{X}_{nt}),$$

$$\textbf{RMA} = (\textbf{M}_{ij} / \textbf{M}_{it}) / (\textbf{M}_{nj} / \textbf{M}_{nt}),$$

where X – are imports, M – are import, i – a country, j – a commodity, n – a set of countries, t – a set of commodities.

The Vollrath index is formulated as:

$$\textbf{RC} = \textbf{lnRXA} - \textbf{lnRMA}$$

There is a big difference in expression of the results in comparison with the Balassa index. Balassa index result is expressed as, if RCA>1, then a comparative advantage is revealed. If RCA<1, then a comparative disadvantage is revealed.

In case of the Vollrath index, **positive results** of the Vollrath index **reveal competitiveness,** and negative values show competitive disadvantage. Balassa and

Vollrath approaches rely on different concepts and that is why they are not strictly comparable. (Utkulu, 2004)

Table 12: Total import data (ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	36 476 654	48 230 794	51 239 343	66 705 682	76 527 310	93 429 474	116 822 197
Hungary	33 681 734	37 611 572	47 674 542	60 248 602	65 919 579	76 978 511	94 659 727
V4	134 375 504	156 736 444	188 660 763	244 565 357	278 211 527	340 811 915	434 862 199
World	6 324 509 730	6 586 827 695	7 682 853 525	9 382 060 863	10 607 834 908	12 245 802 740	14 095 906 118

	2008	2009	2010	2011	2012	2013	2014
CR	141 833 836	104 849 536	125 690 658	150 813 416	139 726 824	142 525 808	153 225 461
Hungary	108 784 724	77 272 443	87 432 095	101 369 997	94 266 239	98 661 803	103 110 997
V4	533 708 631	386 851 760	451 632 314	538 065 223	502 282 527	528 096 513	554 377 917
World	16 352 222 166	12 603 159 274	15 254 895 075	18 238 694 336	18 329 977 181	18 705 114 822	18 729 446 763

Source: Own production, data taken from http://trademap.org/Index.aspx

Table 13: Group 87 – Vehicles other than railway, tramway import data
2001-2014 (ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	2 968 202	4 226 078	4 511 236	6 068 614	6 651 940	8 059 514	10 477 541
Hungary	2 533 611	3 144 375	4 078 617	5 050 277	5 234 158	6 389 591	8 351 815
V4	11 199 979	14 311 290	18 573 537	23 724 797	24 742 723	31 296 665	43 461 322
World	569 592 172	624 514 752	719 881 435	849 220 912	908 568 823	1 014 794 014	1 192 117 811

	2008	2009	2010	2011	2012	2013	2014
CR	12 222 173	8 639 981	9 637 740	11 913 138	11 537 469	12 121 773	14 110 946
Hungary	9 664 425	4 775 326	5 640 265	6 835 185	6 721 255	7 947 695	9 847 504
V4	53 110 604	32 167 850	36 967 073	44 633 630	42 132 951	46 256 544	51 861 953
World	1 233 913 357	855 324 556	1 071 555 294	1 256 263 546	1 287 888 735	1 334 059 087	1 381 365 529

Source: Own production, data taken from http://trademap.org/Index.aspx

When all needed data is available, we can start computing the revealed competitiveness (RC) of the Czech Republic in the global point of view for 2001. Again, note that all of the numbers are in thousands of USD and that is why this research uses the same values as are mentioned in the tables. This research starts with computing of relative import advantage (RMA) because we already have relative

export advantage (RXA) calculated because of Balassa´ RCA is equivalent to Vollrath´s RXA.

The research starts with computing relative import advantage (RMA).

RMA = (M_{ij} / M_{it})/(M_{nj} / M_{nt}),

where X – are imports, M – are import, i – a country, j – a commodity, n – a set of countries, t – a set of commodities.

For calculation of the first bracket **(M_{ij} / M_{it})**, we need to know:

1) a selected country´s import of a given product – in our case it is the whole sector 87 imported to the Czech Republic in 2001 – **2 968 202**
2) the selected country´ total import (all products) – in our case, this number represents the total import to the Czech Republic in 2001 – **36 476 654**

As mentioned above, there is calculated the RMA of the Czech Republic in the global point of view for 2001, and that's why there is used the global (world´s) figures. So for calculation of the second bracket **(M_{nj} / M_{nt})**, we need to know:

3) a set of countries´ import of a given product – in our case, that's the world import of the whole sector 87 in 2001 – **569 592 172**
4) a set of countries´ total import (all products) – in this case, that's global total import in 2001 - **6 324 509 730**

RMA = (Mij / Mit)/(Mnj / Mnt)

RMA (CZE/WOR) 2001 = (2 968 202/ 36 476 654) / (569 592 172/ 6 324 509 730)

RMA (CZE/WOR) 2001 = 0.904

Table 14: Relative import advantage (RMA) of the group 87

	2001	2002	2003	2004	2005	2006	2007
CR/World	0,904	0,924	0,940	1,005	1,015	1,041	1,060
HUN/World	0,835	0,882	0,913	0,926	0,927	1,002	1,043
CR/V4	0,976	0,960	0,894	0,938	0,977	0,939	0,897
HUN/V4	0,903	0,916	0,869	0,864	0,893	0,904	0,883
	2008	2009	2010	2011	2012	2013	2014
CR/World	1,142	1,214	1,092	1,147	1,175	1,192	1,249
HUN/World	1,177	0,911	0,918	0,979	1,015	1,129	1,295
CR/V4	0,866	0,991	0,937	0,952	0,984	0,971	0,984
HUN/V4	0,893	0,743	0,788	0,813	0,850	0,920	1,021

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

In this table above, there are all values of relative import advantage according to Vollrath but do not mistake that these are actual Vollrath indices – they are not.

RC = lnRXA – lnRMA

The formula for calculation of the Vollrath index is above, and that means we need to use the natural logarithm for computing **lnRMA**.

Table 15: ln_RMA of the group 87

	2001	2002	2003	2004	2005	2006	2007
CR/World	-0,101	-0,079	-0,062	0,005	0,015	0,040	0,059
HUN/World	-0,180	-0,126	-0,091	-0,077	-0,076	0,002	0,042
CR/V4	-0,024	-0,041	-0,112	-0,064	-0,023	-0,063	-0,108
HUN/V4	-0,103	-0,088	-0,140	-0,146	-0,113	-0,101	-0,125
	2008	2009	2010	2011	2012	2013	2014
CR/World	0,133	0,194	0,088	0,137	0,161	0,176	0,222
HUN/World	0,163	-0,094	-0,085	-0,021	0,015	0,122	0,258
CR/V4	-0,144	-0,009	-0,065	-0,049	-0,016	-0,029	-0,016
HUN/V4	-0,113	-0,297	-0,238	-0,207	-0,163	-0,084	0,021

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Now, the research will use the Table 5 (Balassa index for the group 87 – Vehicles other than railway, tramway), and there will be used the natural logarithm.

Table 16: ln_RXA of the group 87

	2001	2002	2003	2004	2005	2006	2007
CR/World	0,566	0,638	0,474	0,493	0,618	0,698	0,672
HUN/World	-0,018	-0,099	-0,150	-0,151	-0,022	0,149	0,246
CR/V4	0,268	0,313	0,130	0,117	0,184	0,153	0,094
HUN/V4	-0,316	-0,424	-0,494	-0,527	-0,456	-0,396	-0,332

	2008	2009	2010	2011	2012	2013	2014
CR/World	0,717	0,925	0,870	0,889	0,892	0,910	0,945
HUN/World	0,387	0,289	0,263	0,289	0,335	0,554	0,764
CR/V4	0,040	0,141	0,164	0,158	0,161	0,157	0,162
HUN/V4	-0,290	-0,495	-0,443	-0,442	-0,395	-0,200	-0,019

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Finally, now we have all the needed figures to calculate the actual Vollrath index.

RC = lnRXA – lnRMA

VI (CZE/WORD) 2001 = 0.566 - (–0.101) = 0.667

Note that calculation were made in MS Excel with precise figures, and here in the tables there are used **rounded figures**. That's why the last decimal number (a thousandth) might sometimes differ, as for VI (CZE/WORD) 2001 where with precise figures, the **precise** result is **0.668**.

5.3.1. Analysis of Vollrath index for the 87-group

Table 17: Vollrath index for the group 87-Vehicles other than railway, tramway

	2001	2002	2003	2004	2005	2006	2007
CR/World	0,668	0,717	0,536	0,488	0,604	0,658	0,613
HUN/World	0,162	0,027	-0,059	-0,074	0,054	0,147	0,204
CR/V4	0,292	0,354	0,241	0,182	0,207	0,216	0,203
HUN/V4	-0,214	-0,336	-0,354	-0,380	-0,342	-0,295	-0,207

	2008	2009	2010	2011	2012	2013	2014
CR/World	0,585	0,731	0,783	0,752	0,730	0,734	0,723
HUN/World	0,224	0,383	0,348	0,311	0,321	0,432	0,506
CR/V4	0,184	0,150	0,230	0,207	0,177	0,186	0,178
HUN/V4	-0,177	-0,198	-0,205	-0,234	-0,233	-0,116	-0,039

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Note: Green color indicates presence of RCA

Graph 7: Vollrath index for the group 87-Vehicles other than railway, tramway
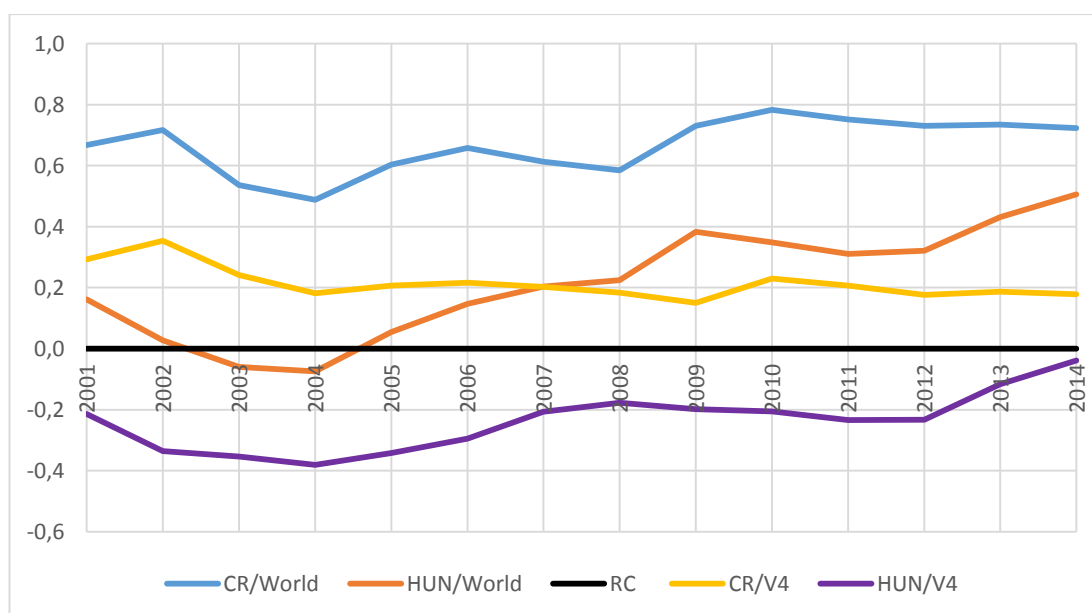
Source: Own production, based on data from http://trademap.org/Index.aspx

The research follows previous instruction and the Table 17 was constructed for all the years covered 2001-2014. Note that according to Vollrath, **revealed competitiveness**

(RC) is occurred if **RC>0**. And revealed competitive disadvantage is revealed when RC<0 (Note: that for Balassa RCA>1, then a comparative advantage is revealed). That is why in the table above some values are colored by green color for better recognition of RC>0. In the Graph 7, there are the same values from the Table 17, only illustrated graphically. The black thick line is a constant that indicates where the line between revealed competitiveness and revealed competitive disadvantage is.

Analysis of Vollrath index for the group 87-Vehicles

With a closer look at the table and the graph, we are able to see that the position of the Czech Republic in comparison with the world and the Visegrad group is according to Vollrath in positive figures. That means the Czech Republic possess revealed competitiveness. We can see, that the Vollrath index of the Czech Republic over the Visegrad group was higher than Hungary over the world until 2006. From that year the Vollrath index of Hungary over the world is higher, and is slightly catching up the Czech Republic over the world. An interesting fact also is that despite Hungarian index over the world is almost always in positive values (except 2003 and 2004) – meaning Hungary possess global RC, Hungary struggled to be in positive values in terms of in comparison with the Visegrad group. The explanation for this result is the fact, that the region of the Central Europe is very developed and active in term of export and import within the group 87 – Vehicles other than railway, tramway, in comparison with the rest of the world. Honestly, it needs to be mention that the Hungarian VI over the Visegrad group is very close to the border of RC, and will probably possess RC in the future, if they keep increasing their production.

5.3.2. Analysis of Vollrath index for 8703 subgroup

Table 18: Subgroup 8703 – Cars import data 2001-2014 (ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	746 507	1 590 556	1 391 749	2 065 817	1 834 756	2 158 615	2 716 646
Hungary	880 001	1 198 899	1 720 343	2 435 607	2 429 516	2 683 429	3 411 895
V4	4 132 654	5 858 006	7 163 939	8 968 511	8 326 438	10 126 154	13 636 657
World	318 930 298	346 784 770	396 246 613	462 354 398	486 449 094	540 707 657	628 125 937

	2008	2009	2010	2011	2012	2013	2014
CR	3 303 294	2 409 953	2 339 422	2 835 413	2 460 863	2 519 236	3 040 384
Hungary	3 277 693	1 049 531	1 498 758	2 043 562	1 905 477	1 947 572	2 316 747
V4	17 300 434	10 344 167	10 934 188	11 738 844	10 734 895	11 276 908	13 421 777
World	634 219 116	442 346 194	551 841 346	634 763 355	647 560 310	671 542 859	701 266 596

Source: Own production, data taken from http://trademap.org/Index.aspx

Table 19: Vollrath index for subgroup 8703-Cars (incl. station wagon)

	2001	2002	2003	2004	2005	2006	2007
CR/World	1,451	1,173	0,948	0,797	1,187	1,329	1,259
HUN/World	0,608	0,282	-0,046	-0,215	-0,059	0,228	0,513
CR/V4	0,665	0,513	0,390	0,216	0,397	0,377	0,316
HUN/V4	-0,178	-0,378	-0,604	-0,796	-0,850	-0,724	-0,430

	2008	2009	2010	2011	2012	2013	2014
CR/World	1,133	1,400	1,604	1,612	1,704	1,678	1,637
HUN/World	0,702	1,247	0,916	0,768	0,890	1,244	1,474
CR/V4	0,289	0,286	0,467	0,362	0,417	0,374	0,375
HUN/V4	-0,142	0,133	-0,221	-0,482	-0,396	-0,061	0,212

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Note: Green color indicates presence of RCA

Graph 8: Vollrath index for subgroup 8703-Cars (incl. station wagon)
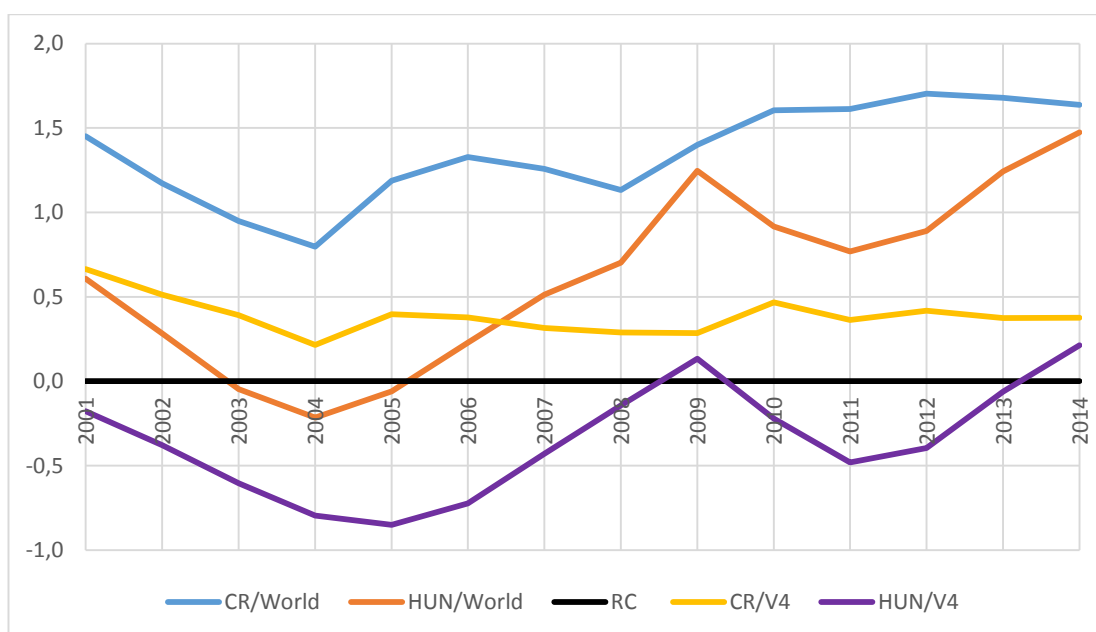
Analysis of Vollrath index for subgroup 8703-Cars

When we have a look at the Table 19 and the Graph 8, we see that the highest revealed competitiveness has again the Czech Republic over the world with its maximums in 2012, followed by the years 2013 and 2014. The Czech Republic over the V4 shows pretty stable values just below 0.5 line, with its maximum in 2001 (0.665), and its minimum in 2004 (0.216). Despite of its drop in 2003 - 2004, Hungary over the world shows mainly RC, with its maximum in 2014 and 2009. Even Hungary over the world is above of the RC line, there was a drop in 2010 – 2011 caused mainly by decrease in demand after the financial crisis in 2008. Hungary over the V4, shows very similar line in the graph as Hungary over the world but it is just about 1.5 VI lower. That means that performance of the Visegrad group was very stable during this observation.

5.3.3. Analysis of Vollrath index for 8708 subgroup

Table 20: Subgroup 8708 – Parts import data 2001-2014 (ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	1 484 515	1 720 666	2 065 420	2 483 467	3 164 902	3 947 483	5 015 058
Hungary	761 282	858 590	1 007 255	1 109 060	1 229 959	1 490 793	2 800 030
V4	4 140 829	4 703 927	6 608 009	8 465 192	9 496 358	12 399 533	17 464 903
World	135 378 134	150 469 918	174 200 307	206 258 778	222 166 841	246 010 165	283 715 986

	2008	2009	2010	2011	2012	2013	2014
CR	5 653 605	4 854 550	5 673 963	7 091 503	7 300 866	7 479 028	8 544 654
Hungary	2 976 034	2 018 806	2 378 062	2 893 601	2 587 260	3 862 642	5 232 050
V4	20 221 639	15 079 392	18 157 304	22 875 777	22 084 410	24 642 974	27 518 511
World	293 561 240	215 585 445	280 374 450	332 307 678	337 401 442	357 064 350	370 796 259

Source: Own production, data taken from http://trademap.org/Index.aspx

Table 21: Vollrath index for subgroup 8708 – Parts & access of motor vehicles

	2001	2002	2003	2004	2005	2006	2007
CR/World	0,342	0,528	0,529	0,586	0,471	0,416	0,426
HUN/World	0,244	0,374	0,541	0,624	0,643	0,666	0,215
CR/V4	0,129	0,155	0,187	0,284	0,186	0,200	0,255
HUN/V4	0,031	0,001	0,200	0,321	0,359	0,450	0,044

	2008	2009	2010	2011	2012	2013	2014
CR/World	0,465	0,309	0,309	0,288	0,188	0,295	0,299
HUN/World	0,189	0,170	0,223	0,247	0,281	0,066	-0,077
CR/V4	0,263	0,146	0,153	0,170	0,114	0,191	0,181
HUN/V4	-0,014	0,006	0,066	0,129	0,208	-0,038	-0,195

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Note: Green color indicates presence of RCA

Graph 9: Vollrath index for subgroup 8708 – Parts & access of motor vehicles
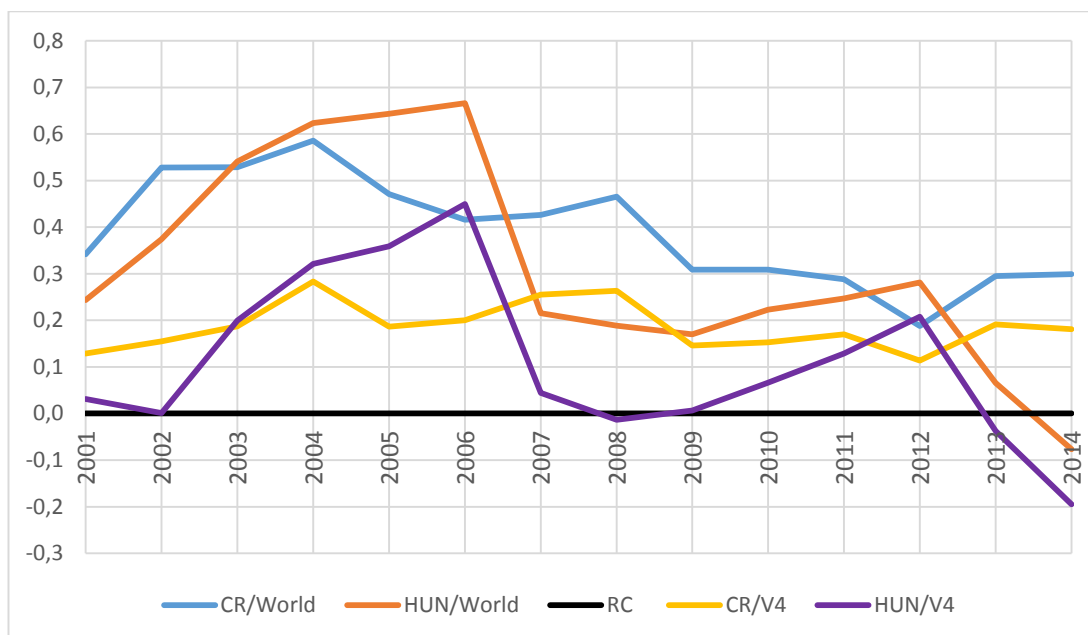
Analysis of Vollrath index for subgroup 8708 – Parts

This graph, based on the results of the Vollrath index for 8708, shows very interesting shapes of lines. As usual, we start with the Czech Republic over the world line. The blue line shows early increase from 2001 to 2004 where the maximum of the line is (0.586). From this point, the line is slightly decreasing with some little exceptions in 2008 and 2013. The Czech Republic over the V4 is more or less stable between 0.1 and 0.3 values. The line representing Hungary over the world is much more interesting. It increases from 2001 – 2006 (with its maximum at 0.666, then it comes a huge drop in 2007 (0.215). As in the previous graph, Hungary over the Visegrad group almost copies the other line of Hungary only with a difference of - 0.3. From 2013, the both lines of Hungary are much closer to each other. Both of the lines ends in the revealed competitive disadvantage area.

5.3.4. Analysis of Vollrath index for 8701 subgroup

Table 22: Subgroup 8701 – Tractors import data 2001-2014 (ths. USD)

	2001	2002	2003	2004	2005	2006	2007
CR	219 488	253 678	226 375	418 577	482 901	623 318	914 475
Hungary	140 719	184 424	291 784	309 436	274 081	338 069	530 493
V4	641 663	889 072	1 268 314	1 829 143	1 935 331	2 561 763	4 159 282
World	15 180 015	17 566 564	21 139 455	28 046 240	30 623 620	36 027 357	43 353 596

	2008	2009	2010	2011	2012	2013	2014
CR	949 807	270 685	436 149	730 619	597 285	730 247	907 954
Hungary	670 811	238 518	172 825	382 269	384 818	478 773	614 493
V4	4 125 539	1 421 368	2 102 005	3 375 571	3 105 837	3 618 261	3 754 663
World	51 120 903	27 423 333	33 000 268	47 457 859	48 164 549	49 970 911	52 399 221

Source: Own production, data taken from http://trademap.org/Index.aspx

Table 23: Vollrath index for subgroup 8701 – Tractors (other than Tractors 8709)

	2001	2002	2003	2004	2005	2006	2007
CR/World	-1,405	-1,384	-0,974	-1,348	-1,143	-1,100	-1,242
HUN/World	-3,048	-3,032	-3,311	-2,630	-2,555	-2,087	-2,077
CR/V4	0,103	0,399	1,068	0,771	0,670	0,460	0,376
HUN/V4	-1,541	-1,250	-1,269	-0,511	-0,742	-0,527	-0,459

	2008	2009	2010	2011	2012	2013	2014
CR/World	-1,166	-0,431	-0,927	-1,198	-0,893	-1,043	-1,268
HUN/World	-1,877	-1,562	-0,778	-1,433	-1,457	-1,700	-2,073
CR/V4	-0,055	0,281	0,088	-0,044	0,180	0,114	-0,026
HUN/V4	-0,766	-0,850	0,237	-0,279	-0,384	-0,543	-0,831

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Note: Green color indicates presence of RCA

Graph 10: Vollrath index for subgroup 8701 – Tractors (other than Tractors 8709)
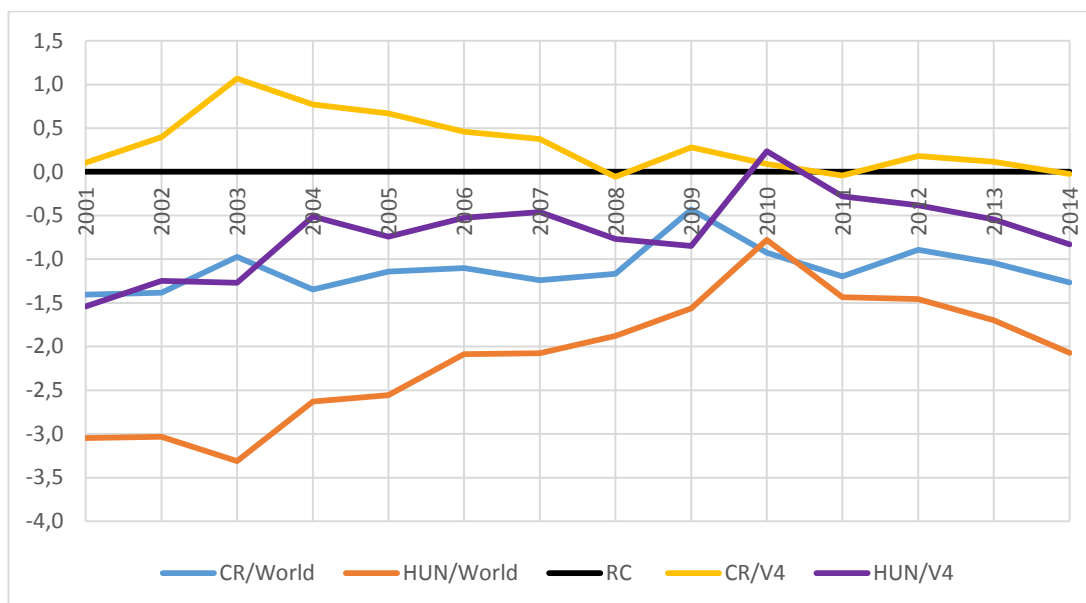
Analysis Vollrath index for subgroup 8701 – Tractors

It is not usual, that the Czech Republic over the world in not on the top in terms of Vollrath index. For the all observed years, the Czech Republic has over the world revealed competitive disadvantage. The lowest index is detected in the first year of the observation with almost -1.5 value. On the other hand, there is the maximum value in 2009 (despite of the financial crisis). The line of the Czech Republic over the V4 shows revealed competitiveness for the whole time, except two years – 2008 and 2011 – when it was just a bit below the black thick line that represents the RC. The highest value was detected in 2003, with just a bit above one. An interesting fact is, that Hungary over the V4, shows higher values than Hungary over the world. That means than the Visegrad group as itself probably possess revealed competitive disadvantage over the world. Hungary over V4 has only one positive value – in 2010 with 0.237 revealed competitiveness. Hungary over the world shows very high disadvantage and the trend from 2010 is still decreasing.

5.4.   Lafay index calculation

Lafay index (LFI) of international specialization analyze comparative advantage or disadvantage of a country in a specific good (or subsector, sector) in comparison of the trade balance of the specific good, with total trade balance of the country. While taking into account rate of exchange of the specific good in the total turnover of the total trade.

The Lafay index does not measure comparative advantage in comparison with other country (or a set of countries). It measures comparative advantage in comparison to the total structure of trade of a given country. Positive values of LFI show comparative advantage of a given product in the total structure of trade of a given country. That means that there will not be that many rows in the final tables because we will measure only comparative advantage (or disadvantage) of a given product within the total structure of trade of a given country. In other word, the LFI combines together trade and production variables. Using this index we consider the difference between each item's normalized trade balance and total normalized trade balance.

For a given country, *i*, and for any given product *j*, the Lafay index is formulated as:

$$LFI_j^i = 100(\frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_{j=1}^{N}(x_j^i - m_j^i)}{\sum_{j=1}^{N}(x_j^i + m_j^i)})\frac{x_j^i + m_j^i}{\sum_{j=1}^{N}(x_j^i + m_j^i)}$$

There are used values from previous tables and there is no need to put them in this chapter again. The values needed for computing Lafay index of the Czech Republic for the whole 87-group in 2001 are following:

1) a selected country´s export of a given product – in our case it is the whole sector 87 exported by the Czech Republic in 2001 – **5 334 871**

2) the selected country´ total export (all products) – in our case, this number represents the total export of the Czech Republic in 2001 – **33 384 210**

3) a selected country´s import of a given product – in our case it is the whole sector 87 imported to the Czech Republic in 2001 – **2 968 202**

4) the selected country´ total import (all products) – in our case, this number represents the total import to the Czech Republic in 2001 – **36 476 654**

$$LFI_j^i = 100(\frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_{j=1}^{N}(x_j^i - m_j^i)}{\sum_{j=1}^{N}(x_j^i + m_j^i)})\frac{x_j^i + m_j^i}{\sum_{j=1}^{N}(x_j^i + m_j^i)}$$

LFI [2001] (CZE, 87) = 100 x [(5 334 871-2 968 202) / (5 334 871+2 968 202) – (33 384 210-36 476 654) / (33 384 210+36 476 654)] x [(5 334 871+2 968 202) / (33 384 210+36 476 654)] = **3.914**

The research follows previous instruction for years 2002 - 2014 as it was done for the Czech Republic for 87-group in 2001. On the next page, there is a full table of figures for the Czech Republic and Hungary

5.4.1. Analysis of Lafay index for the 87-group

Table 24: Lafay index for the group 87-Vehicles other than railway, tramway

	2001	2002	2003	2004	2005	2006	2007
CR	3,914	4,691	3,249	3,008	3,839	4,165	3,925
HUN	0,690	0,166	-0,177	-0,222	0,346	0,744	1,081

	2008	2009	2010	2011	2012	2013	2014
CR	3,640	4,544	4,765	4,611	4,544	4,662	4,886
HUN	1,274	1,500	1,457	1,330	1,413	2,222	3,157

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx
Note: Green color indicates presence of comparative advantage (CA)

Graph 11: Lafay index for the group 87-Vehicles other than railway, tramway
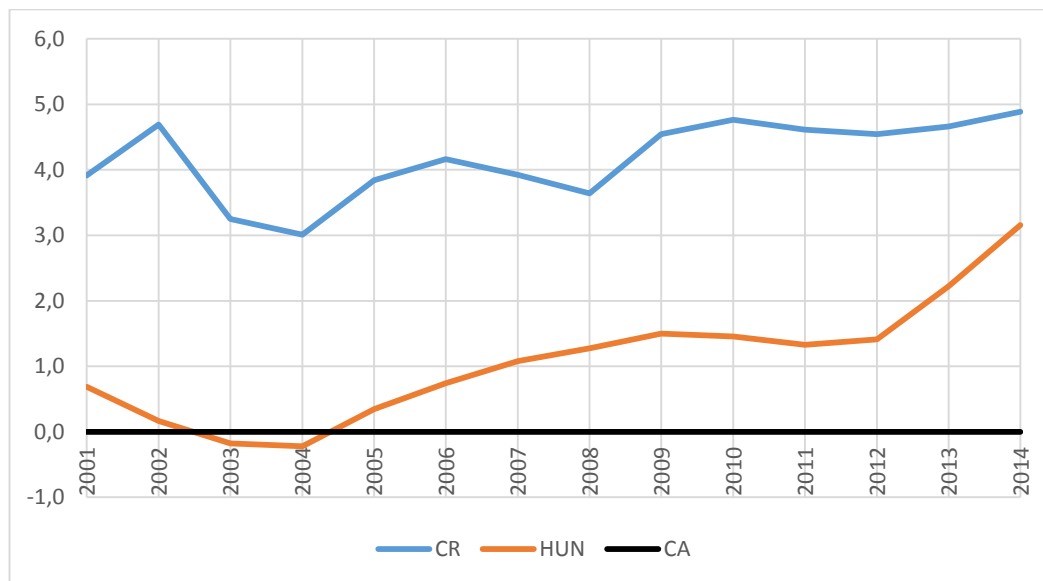
Analysis of Lafay index for the group 87-Vehicles

In the table and the graph above, there is visible, how the Czech Republic has a great level of specialization in the 87-group (Vehicles other than railway, tramway) in comparison with its all other exported products. All figures of the Czech Republic are positive, the highest one is in 2014, and the lowest figure is in 2004. Higher the LFI is, higher the degree of specialization and comparative advantage in comparison with other products exported is.

Obviously, there is a great difference in the first a couple of years between Hungary and the Czech Republic. Hungary had between 2003 – 2004 negative degree of specialization in comparison but it was not a dramatic disadvantage, and since that the production of the 87-group (mostly cars) has increased rapidly. Between the years 2012 – 2014, the Lafay index more than doubled. There is visible the positive trend for Hungary.

5.4.2. Analysis of Lafay index for the 8703 subgroup

Table 25: Lafay index for subgroup 8703-Cars (incl. station wagon)

	2001	2002	2003	2004	2005	2006	2007
CR	3,345	3,783	2,221	1,942	2,837	3,275	2,998
HUN	1,095	0,562	-0,045	-0,364	-0,059	0,480	1,257

	2008	2009	2010	2011	2012	2013	2014
CR	2,553	3,539	3,793	3,831	3,965	3,851	4,101
HUN	1,617	1,700	1,329	1,192	1,459	2,442	3,786

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx
Note: Green color indicates presence of comparative advantage (CA)

Graph 12: Lafay index for subgroup 8703-Cars (incl. station wagon)

Source: Own production, based on data from http://trademap.org/Index.aspx
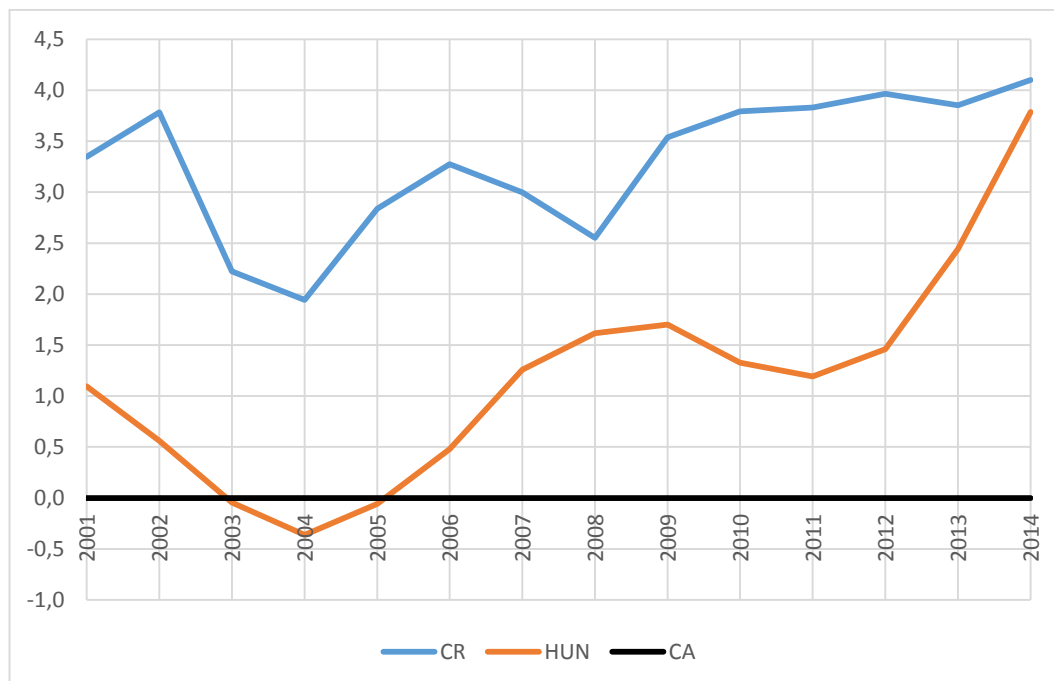
Analysis of Lafay index for subgroup 8703-Cars

The table above is very similar to the table of Lafay index for the group 87 (Table 24). That means that cars (8703 subgroup) are one of the key elements included within the group 87. The minimums and maximums occurred in the same years. All figures of the Czech Republic are positive, the highest one is in 2014, and the lowest figure is in 2004. Higher the LFI is, higher the degree of specialization and comparative advantage in comparison with other products exported is. Obviously, there is a great difference in the first a couple of years between Hungary and the Czech Republic. Hungary had between 2003 – 2004 negative degree of specialization in comparison but it was not a dramatic disadvantage, and since that the production of the 87-group (mostly cars) has increased rapidly. Between the years 2012 – 2014, the Lafay index more than doubled. There is visible the positive trend for Hungary.

5.4.3. Analysis of Lafay index for the 8708 subgroup

Table 26: Lafay index for subgroup 8708 – Parts

	2001	2002	2003	2004	2005	2006	2007
CR	0,868	1,273	1,475	1,582	1,382	1,205	1,222
HUN	0,332	0,536	0,794	0,846	0,916	0,983	0,401

	2008	2009	2010	2011	2012	2013	2014
CR	1,283	0,965	0,970	0,903	0,629	0,952	0,988
HUN	0,337	0,304	0,424	0,468	0,498	0,166	-0,174

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx
Note: Green color indicates presence of comparative advantage (CA)

Graph 13: Lafay index for subgroup 8708 – Parts & access of motor vehicles
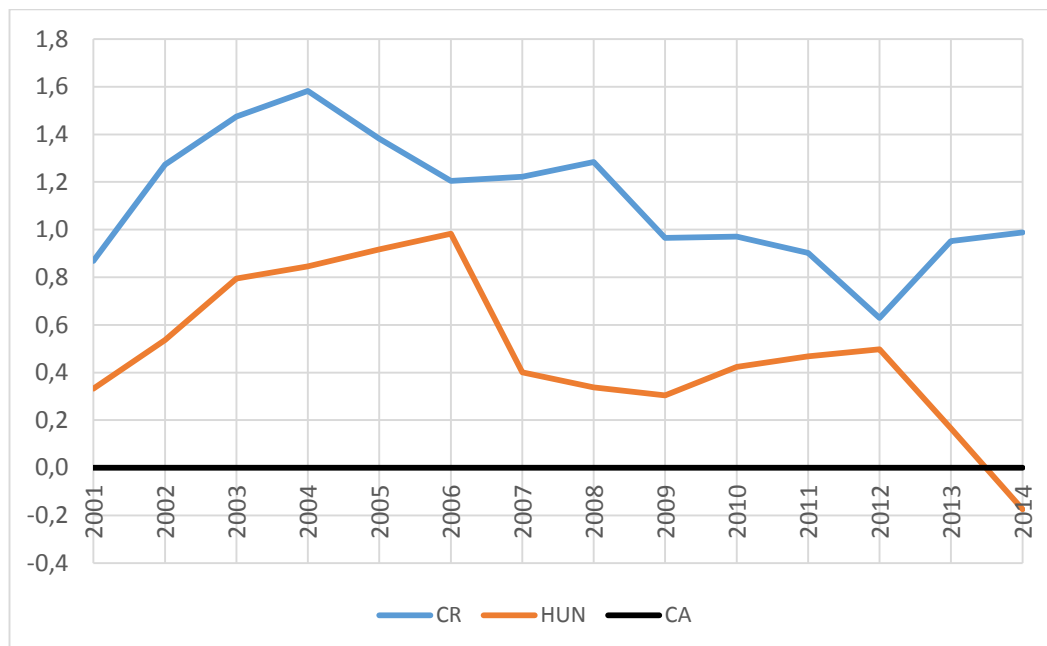
Analysis of Lafay index for subgroup 8708 – Parts

The curve of Lafay index for the Czech Republic increases in the first three years of the observation until 2004. Then, there is visible slight decrease between 2004 and 2006. The curve went a little bit up again in 2008 and 2009. But then the financial crisis occurred and the curve is decreasing again until its minimum in 2012 when the Lafay index for the Czech Republic in terms of 8708 shows 0.629 value. In 2008, there was the last time when the curve was above the value of 1. The last two years of observation show some increase again, and obviously is still in positive values.

The curve for Hungary shows similar increase in the five years of the research. In 2006, there was the maximum with its value just a bit under 1 (0.983). Between 2006 and 2007 the live drops rapidly, and the decrease keeps continue for the next two years. In comparison with the Czech curve which from the year 2009 keeps falling, the Hungarian line goes up. It is not any dramatic increase but still during the financial crisis, it is very positive trend. The curve increased in 2012 for the last time of this observation, and since that year, the Hungarian line keep falling to negative value in 2014.

5.4.4. Analysis of Lafay index for the 8701 subgroup

Table 27: Lafay index for subgroup 8701 – Tractors (other than Tractors 8709)

	2001	2002	2003	2004	2005	2006	2007
CR	-0,219	-0,188	-0,125	-0,218	-0,198	-0,210	-0,265
HUN	-0,197	-0,231	-0,292	-0,235	-0,189	-0,189	-0,241

	2008	2009	2010	2011	2012	2013	2014
CR	-0,216	-0,038	-0,096	-0,158	-0,114	-0,157	-0,206
HUN	-0,254	-0,119	-0,047	-0,136	-0,150	-0,194	-0,257

Source: Own calculation and production, data taken from http://trademap.org/Index.aspx

Note: Green color indicates presence of comparative advantage (CA)

Graph 14: Lafay index for subgroup 8701 – Tractors (other than Tractors 8709)

Source: Own production, based on data from http://trademap.org/Index.aspx
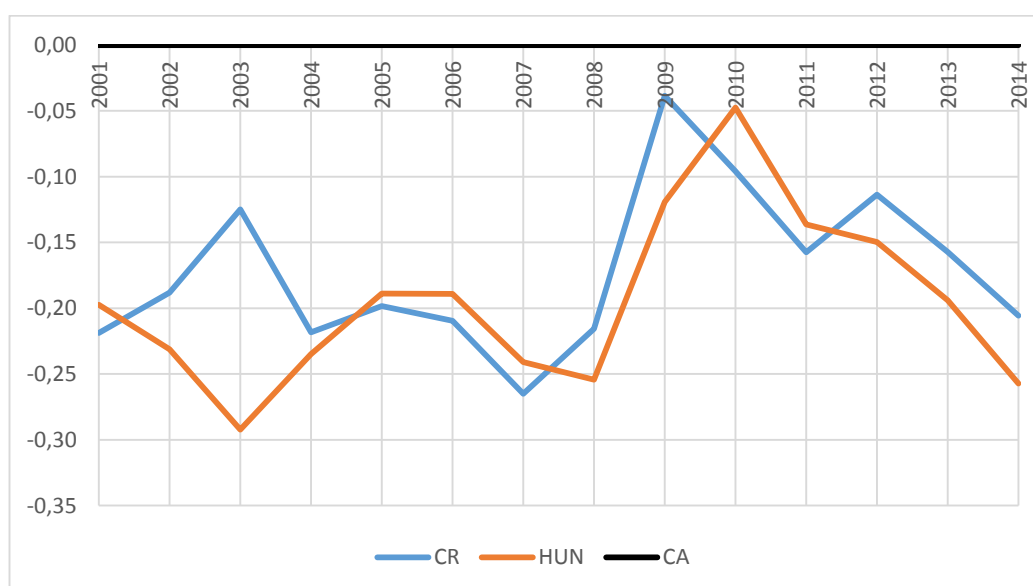
Analysis Lafay index for subgroup 8701 – Tractors

Tractors are the only product that show for both countries comparative disadvantage. The curves of both countries have totally different trends during the first four years of the research.

The Lafay index for the Czech Republic product starts with a slight increase in 2002 and 2003. Then the values for following three to four years keep increase and decrease by a bit, when it finally hits its minimum in 2007 with -0.265. The curve increased hugely from 2008 and 2009, where it hits its maximum of -0.038 and it's just under the comparative advantage black thick line.

The Lafay index of Hungary in term of its specialization degree in comparison with other products falls for both first years in the research. In hit its minimum in 2003 with -0.292. There are some increases and decreases in the following a couple of years until 2008. When it finally hits its maximum in 2010 with -0.047. From that years, the curve is just keep decreasing and ends in more negative values than it actually started.

6. Conclusion

The main objective of this thesis is to investigate whether the Czech Republic has a comparative advantage or disadvantage of its automotive sector between 2001 and 2014. The investigation will be done from the global point of view as well as from the point of view of the Visegrad group for Balassa and Vollrath indices. The automotive sector is in this thesis represented by the group 87 which represents products as cars, parts for the group 87, buses, motorcycles, and others.

The research graphs and tables showed that the Czech Republic does have comparative advantage in producing and exporting the automotive sector. There were all positive values, and values above 1 where needed which showed the revealed comparative advantage in case of Balassa index. In case of Vollrath, there were only positive values that indicate the reveal competitiveness. In case of Lafay index, the index does not reveal comparative advantage in comparison with other country or a set of countries but it showed that the automotive sector of the Czech Republic has comparative advantage in terms of its position in economy of the Czech Republic. In other words, it can be stated that the degree of specialization is in positive values.

The other objective is to investigate whether the Czech Republic has a comparative advantage in selected subgroups, such as cars (8703), parts (8708), and tractors (8701).

The research graph and tables showed that the Czech Republic does have comparative advantage in producing and exporting selected subsectors with just one exception. The exception are Tractors (8701). The Czech Republic has the comparative advantage only over Hungary for all selected years but from global point of view and from point of view of the Visegrad group there is comparative disadvantage for most of the years. The Lafay index shows very low degree of specialization within the Czech total export and import.

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8. Appendix

Image 1: Czech exports structure in 2013

Image 2: Czech imports structure in 2013

Image 3: Hungarian exports structure in 2013

Image 4: Hungarian exports structure in 2013

Table 1: Total export data (in ths. USD)

Table 2: Total import data (in ths. USD)

Table 3: Export data of the group 87 (in ths. USD)

Table 4: Total export data (in ths. USD)

Table 5: Balassa index for the group 87-Vehicles other than railway, tramway

Table 6: Export data of the subgroup 8703 (in ths. USD)

Table 7: Balassa index for subgroup 8703-Cars (incl. station wagon)

Table 8: Export data of the subgroup 8708 (in ths. USD)

Table 9: Balassa index for subgroup 8708 – Parts & access of motor vehicles

Table 10: Export data of the subgroup 8701 (in ths. USD)

Table 11: Balassa index for subgroup 8701 – Tractors (other than Tractors 8709)

Table 12: Total import data (ths. USD)

Table 13: Group 87 – Vehicles other than railway, tramway import data 2001-2014 (ths. USD)

Table 14: Relative import advantage (RMA) of the group 87

Table 15: ln_RMA of the group 87

Table 16: ln_RXA of the group 87

Graph 14: Lafay index for subgroup 8701 – Tractors (other than Tractors 8709)