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## ANALYZING CHANGES IN INTERNATIONAL COMPETITIVENESS POSITION OF VISEGRAD GROUP VIS-A-VIS EU-15 AFTER THE CRISIS 2007 AS MEASURED BY RCA INDEX

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### *Abstract*

*The aim of this paper is to find out whether financial crisis of 2007-8 has changed the Visegrad Group – V-4 competitiveness position vis-a-vis EU-15. As we know the countries of Central Eastern Europe forming the so called Visegrad group – namely Poland, The Czech republic, Slovakia and Hungary – being since 2004 a new UE members, have been hit by the financial crisis of 2007 to some extent just as well as the old EU or EU-15 member states. In this paper we would like to investigate and compare how strongly the financial crisis have impacted the two set of countries or the two groups of EU members – old and new, when measured by their respective macroeconomic performance indicators of competitiveness as well as by the RCA indicators of international competitiveness position and trends in it since that time.*

*By the changes in competitiveness position on macro level we understand changes in „magic quadrangle” indicators such as: GDP growth changes, changes in inflation, in unemployment and changes in balances of current accounts. By the RCA positive changes or improvements we understand a growing number of goods or group of goods which contain a high innovative input measured in turn, by high R&D expenditures share in the final value of the exported goods.*

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JEL Classification Codes: **F10**.

**Keywords:** international competitiveness, GDP growth, RCA, financial crisis.

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## **Introduction**

As indicated in the title of this paper we would like to investigate and measure the impact of the financial crisis of 2007 on changes in competitive positions of the two groups of EU members-old and new ones, namely – the so called Visegrad group (Poland, The Czech republic, Slovakia and Hungary) – being new UE members since 2004, and the old EU or EU-15 member states. This analysis might indicate which group of countries – V-4 or old EU has been less or more resistant to the negative effects of the crises on their economic performance and changes in their international competitiveness position.

To achieve this goal we have implemented a number of tools to assess competitiveness of these countries such as: economic growth performance as measured by magic quadrangle indicators (namely – changes in GDP, inflation, unemployment and current account), changes in productivity levels and tendency of its change, innovativeness and entrepreneurial attitude, and, finally, quality and scale of education indicators – all on macro level of aggregation.

As for mezzo and micro level, we have employed several performance indicators such as being used by World Bank methodology in their annual reports on „Ease of doing business”. Finally, we had examined international competitiveness of both set of countries as measured by revealed comparative advantage – RCA indexes confronted against Standard International Trade Classification – SITC modified by high tech inputs factor. This last part has been treated by us in this paper as the main area of our research analyses because international competitive position change is the most important and/or the ultimate measure of the countries’ economic policy effectiveness in the longer run.

### **1. How to measure Visegrad competitiveness; some methodological aspects**

There is plenty of ways to measure countries economic power as well as their competitiveness – the problem is the scope of the analyses and selection of appropriate tools to do the job.

As for the scope we have macro approach, mezzo (sectoral and/or regional) and micro one and all may be equally important when we confront the power of two or more countries/economies to compare it for various reasons. Measuring prowess or effectiveness and flexibility gives the nominal economic power a dynamic dimension of its ingrained factors, which is necessary to have a better feeling of a value/weight of the accumulated potential.

Competitiveness, in turn, could be measured various ways as well. First, by analyzing the current results as an outcome of the accumulated assets strength or weight in the past – and that we can call competitive position or level of competitiveness, or, secondly, we may try to measure factors of competitiveness in

a dynamic way by assessing the factors probable strength and its impact on an ability to maintain and/or to increase the already achieved competitive position.

The second approach can be called a long run ability to compete measure or competitiveness ability. The second approach is a bit more ambitious for it requires deeper or a kind of „tomographic” analysis of the significance of factors of competitiveness as opposed to „photo” type of approach when it comes to measuring competitiveness position, because the last method is usually based on statistical observations mostly. In our analyses in this paper, we will use both methods as to provide a kind of background information on the Visegrad countries and economic growth and competitiveness.

### **1.1. Measures of competitiveness related to macro level**

No doubts the GDP and its level is critical to assess a country economic position vis-a-vis other countries and indirectly, its competitiveness, especially when we add GDP growth rates in the longer run as a criterion. When GDP growth rates exceeds that of other countries for a longer period that usually indicates a country more efficient use of resources, which leads to higher competitiveness as well. As the result, GDP per capita may be used as a proxy for competitiveness position because it comes as the result/except for countries of abundance of natural resources pc/of more efficient uses of assets due to better policies of the country in question.

Equally important of course is the structure of the produced GDP, which should change over time as to reflect the ever changing market requirements for technological upgrading due to new needs. A country ability for structural adjustment as reflected in GDP composition changed over time indicate usually a country ability to compete in the longer run as well.

For the positive GDP growth assessment as a criterion of economic power and competitiveness, we need to have other macro growth indicators to be positive as well. Namely, GDP growth should be assessed as a positive sign when it comes together with low or moderate inflation and when it creates more jobs helping to lower unemployment or to make it stay at the acceptable, say NAIRU level. Another indicator of healthy growth and competitiveness improvement could be a balanced balance of payment so that the country indebtedness is not to become a problem hampering growth and competitiveness in the longer run when its size, in proportion to GDP, exceeds the safe limits for a particular country [Bienkowski 1993, 1995].

The above elaboration on „Policy mix” and „Magic quadrangle” was important because it explains why we will use „Magic quadrangle” as a measure to assess economic potential and competitiveness position of a country. Simply, positive signs of „Magic quadrangle” indicators (GDP growth, inflation level, employment

growth or unemployment level change and balance of payment) will be used as indicators of the rightness of choice and/or effectiveness of a country economic policy direction and, indirectly, a sound foundation for the country ability to compete in the longer run. We will examine and confront and Slovakia, Poland, Hungary and the Czech Republic versus EU-15 economies using this measure.

As for other macro indicators of the sectoral character on macro level we will use comparisons on productivity, innovativeness, science and education, to mention most important ones, to confront the two set of countries potential and competitiveness.

Productivity is usually one of the best indicators of economic power, prowess and competitiveness. It can be measured various ways: as GDP or production per capita, per number of actually employed labor, or per hour of work. The last measure seems to be most adequate for it is the best reflection of the efficiency of the economy. However, there is a caveat no to be missed if we want to make a final judgment on competitiveness of the country or industry or firm. Namely, we have to confront the productivity with the cost factor. The corrected measure is called unit labor cost-ULC and compares growth in productivity to the changes in the cost of labor or wages. For the country or a firm to be competitive in the longer run the best thing is when productivity grow faster than costs and therefore  $ULC < 1$  and is lower than in the country we compare it with. In other words, when confronting and/or comparing productivity levels and productivity growth rates between V-4 and EU-15 we will have to add the ULC as a measure of competitiveness as well. As we may see the productivity superiority is not enough when cost factors/wages, currency appreciation, etc., eat up the surplus and, as a result, production or a particular product will lose price competitiveness when  $ULC > 1$  or higher than that of competitors.

Innovativeness, science and education levels are equally important factors of power and competitiveness of countries. We will measure innovativeness by number of patents registered and implemented.

Science will be measured by R&D expenditures as share or % of GDP in both countries over time with an important division or distinction between the expenditures financed by private sector and by public money. As most economists and experts admit, the proportion between this two sources of financing are important because the efficiency, as measured by returns to investment, are higher when private sector takes biggest chunk of the financing. We will compare the R&D nominal values, its share in GDP in Slovakia, Poland, Czech Republic and Hungary vs EU-15 and take it into consideration when we compare science in both parties. [Bienkowski, Weresa, Radlo, 2009].

## 1.2. Measures of competitiveness related to micro levels

With respect to micro level of our analyses, we will concentrate on institutional environment of medium and small enterprises – SME to compare friendliness of the government policy towards SME business in Slovakia as well as in Poland, Hungary and the Czech Republic vs EU-15. For this analysis, we will employ the World Bank methodology as developed and mastered in the subsequent annual „Business Reports” in 2003–2014 when business environment in 185 countries of the world has been monitored and analyzed. We will enrich the observation by confronting the results with similar research works provided on annually bases by the Freedom House, The Heritage Foundation as well as by Fraser Institute. The comparative analyses will provide us with better sense of the institutional environment, in set of countries conducting to entrepreneurship on SME level, enhancing or hampering growth and competitiveness on mezzo and micro level.

## 1.3. Measures to assess international competitiveness

To assess competitiveness fully we will concentrate on the dominant goods which are technologically most advanced or which have a substantial high tech components because these are the categories which are growing faster than other demand segments on leading markets. The ability to follow and catch up with fastest growing segments can be a good proxy of the country international competitiveness. To conduct the analyses we will employ old but still valid Bella Balassa Revealed Comparative Advantage – RCA index to look for countries that is EU-15 and V-4 specializations, namely,

$$RCA = \frac{\frac{E_{ij}}{E_{it}}}{\frac{E_{nj}}{E_{nt}}}$$

where:

$E$  – export,

$i$  – country index,

$n$  – set of countries,

$j$  – commodity index (chosen commodity from SITC classification),

$t$  – set of commodities (All SITC commodities).

And then we will confront  $RCA > 1$  with the goods taken from Standard International Trade Classification – SITC tables which are considered as advanced technologically ones (Eurostat). That will allow us to assess competitiveness of the export composition during the analyzed period. Criterion being the bigger

and/or growing share of respective RCA in respective countries export structure meeting the goods sophistication taken from SITC tables as described in the model<sup>3</sup>.

## **2. Estimating competitiveness position of V-4 and EU – 15 in recent years and at present**

### **2.1. V-4 economic potential and its effectiveness vis-a-vis EU-15**

To begin with it is good to realize that we are to analyze small and medium countries of EU, recently being transformed from planned economies with all drawbacks or legacies of the previous system and its geopolitical dependency and therefore, or as the result, relatively poor in terms of GDP per capita and less technologically advanced or innovative. As we can see from the data depicted in Table 1 below even most developed countries of our concern like the Czech republic cannot much GDP pc levels of EU-15 average or R&D expenditures to GDP levels in countries in EU-15. Let us underline that GDP ppp total of V-4 represent less than ca 10,7% of the EU-15 GDP ppp total. The respective data for GDP ppp per capita (average for both group) in V-4 represent ca 54% of the EU-15 GDP ppp pc in 2014 (Table 1).

### **2.2. Measuring V-4 competitiveness by macro indicators**

As described in the methodological part of the paper the first macro indicator of a country competitiveness illustrating it in a comprehensive way is the „magic quadrangle” one, which consist of GDP growth rate, inflation and unemployment levels and balance of payment situation at the same time. A country ability to maintain fast growth rate, low levels of inflation and unemployment as well as equilibrium in balance of payment situation in the longer run compared with the respective countries of reference, indicate competitiveness potential and/or a change of it over time. As we can see from the data depicted in the Table 2

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<sup>3</sup> The RCA index as developed by Bella Bellasa decades ago have been used extensively since its invention. Yet sometime it has been used in the wrong way because the formula did not fit to explain some special cases. For example it has been used to assess socialists countries competitiveness which definitely have had based their specializations and therefore have structured their exports composition not in accord to normal or prevailing market condition but they had been allocating their factors of production in accord with respective sectors in accord to the s Yet, the remaining macro indicators at present (2014) demonstrate V-4 and compatibility with EU in terms of GDP rate of growth (even suppressing that of EU average), unemployment and inflation levels or the exposure to international transactions or globalization by being more open to international trade as measured by export plus imports to GDP ratio compared to EU average (Table 1).

Table 1. General Macroeconomic indicators for Visegrad group. 2014

	GDP, PPP	GDP per capita, PPP (average for groups)	GDP growth, annual, % (average for groups)	Foreign Trade (% of GDP) (average for groups)	R&D (% of GDP) (average for groups)	Inflation, GDP deflator, annual, % (average for groups)	Unemployment, total, % of labor force (average for groups)	Expenditure on education as % of total government expenditure (%) (average for groups)
Czech Republic	\$319 billion	\$30 407.4	2	161	1.91	2.5	6.2	10.4
Hungary	\$243,7 billion	\$24 720.6	3.7	171	1.41	3.2	7.8	9.4
Poland	\$940,1 billion	\$24 744.5	3.3	94	0.87	0.4	9.2	11.1
Slovak Republic	\$150,1 billion	\$27 711.5	2.5	180	0.83	-0.2	13.3	9.8
EU-15	\$15495 billion	\$4 216.81	1.4	53	2.02	0.9	10.2	-
V-4	\$1652, billion	\$26 396	2.875	151,5	1.255	1.475	9.125	10.175

Source: World Bank, 2016

Table 2. „Magic quadrangle” data for Visegrad Group and EU-15. Average for the period 2005–2014

Country	GDP growth, %	Inflation, GDP deflator, %	Unemployment, total (% of total labor force)	Current account balance (BoP, current US\$)
Czech Republic	2.15	1.26	6.56	-3 685 046 937
Hungary	0.92	3.45	9.09	-2 342 560 636
Poland	3.84	2.46	10.53	-17 749 000 000
Slovak Republic	3.93	1.19	13.15	-2 305 343 853
V-4	2.71	2.09	9.8325	-6 520 487 857
EU-15	0.98	1.7	8	5 321 931 904

Source: World Bank, 2016.

below the V-4 magic quadrangle indicators cannot provide us with a definite answer which country of the group has perform better way on this comprehensive account compared with the rest of the group during the 2004–2014 period (Table 2).

Looking at the data on macro performance of V-4 and EU-15 contained in Table 2, an analyzing them on individual bases on one hand we could see Poland and Slovakia performing better way with respect to GDP growth in 2004–2014 period over the remaining countries in question with Poland being even most stable during and after the big financial crisis of 2008–2010 (see Figure 1). Yet these countries have had the highest unemployment level at the same time and the levels remained the highest in the group up to 2014 (Figure 3). The only country which could be easily distinguished within the group is Hungary but in a negative way because the country GDP growth has been the lowest in the period, inflation was the highest in the group and unemployment was higher than in or the Czech Republic, almost matching that of Poland at that time.

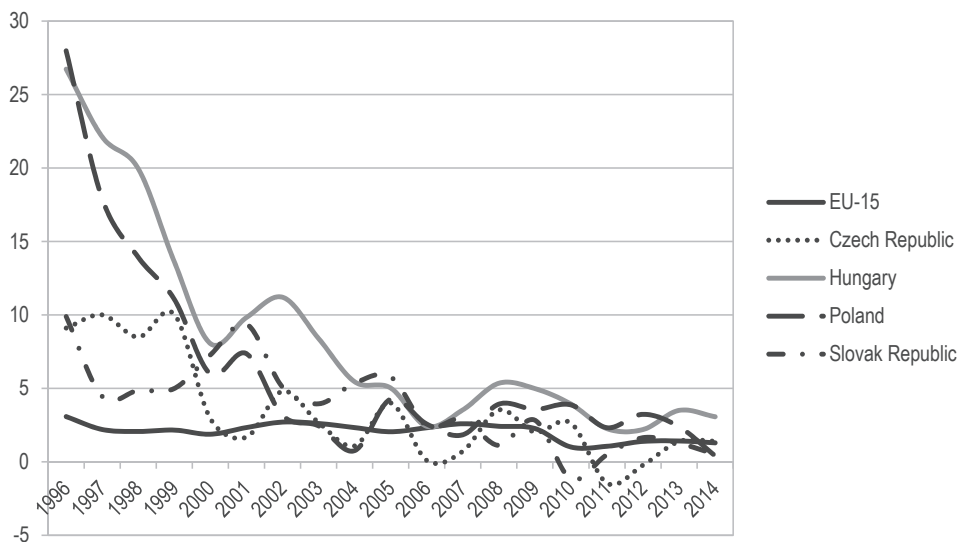
Trying to answer the most important question in this paper that is on comparing V-4 total and EU-15 countries performance by using magic quadrangle indicator we cannot come with the definite answer either. V-4 as a group grew faster than EU-15, yet both unemployment level and inflation level were higher in V-4 than in EU-15 at that time. So that again, like on individual bases – the V-4 members countries provide us with uneven performance data on GDP, inflation, and unemployment levels and/or trends so that we cannot come with a definite judgment on superiority of either group with respect of macro indicators at this stage of our analyzes at the after the financial crises period (see Figure 1–3).



Figure 1. GDP growth, annual, %. Visegrad group vs. EU-15

Source: World bank, 2016.





**Figure 2.** Inflation, GDP deflator, %, annual. Visegrad group vs. EU-15

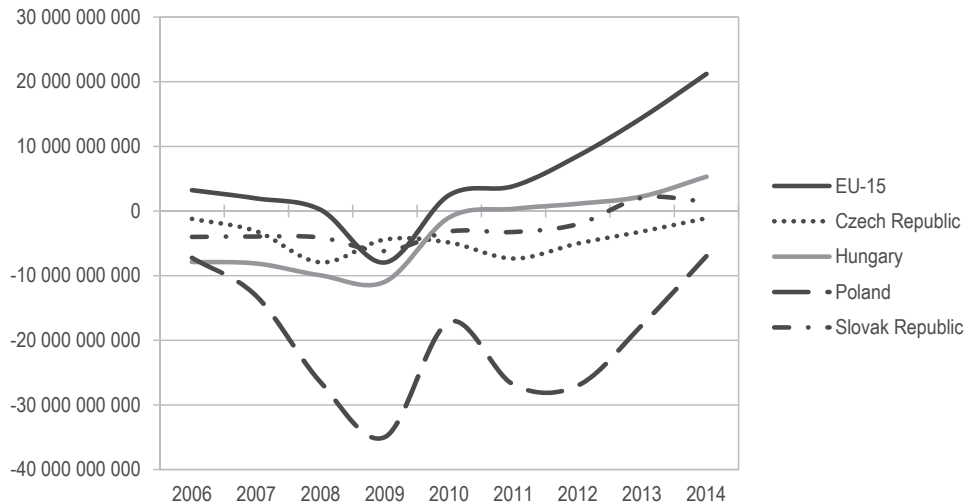
Source: World bank, 2016.



**Figure 3.** Unemployment, total (% of total labor force). Visegrad group vs. EU-15

Source: World bank, 2016.

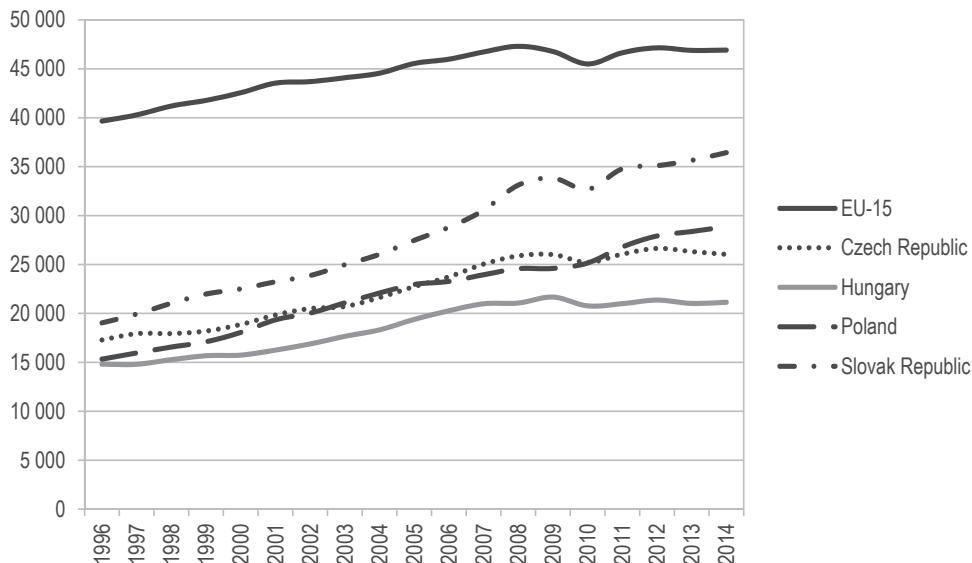
The only indicator which illustrates the superiority of EU-15 members over V-4 has been positive balance of payment situation – measured cumulative way at that time, but that is not enough to make a final judgement especially since by the end of the period analyzed all of the V4 countries have balanced or significantly improved their balances by 2014 (see Figure 4).



**Figure 4.** Current account balance (BoP, current US\$). Visegrad Group vs. EU-15

Source: World Bank, 2016.

As the indicators of the magic quadrangle for V-4 and EU-15 in 2007–2014 presented the mixed results the conclusions related to comparative macro performance of the two groups of countries are mixed as well and not allowing us provide us with a definite answer at this stage who performed better way at that period similar mixed conclusion have to be drawn with respect to a kind of compressed or final macro indicator which is the GDP per capita change for the two groups of countries at that period as we could see that from the data depicted on Graph 5 below. As illustrated by the Graph 5 – both, EU-15 and V-4 have had reduced their GDP pc immediately after 2007–2008 (with the exception of Poland) and the decline lasted 2–3 years after the pick of the crisis with slight recuperation soon after 2009 in EU-15. As far as V-4 is concerned only Slovakia and Poland did relatively well and their GDP grew above the EU-15 rate at that period but the Czech Republic and Hungary have not been able to do so well following for most part the EU pattern (Figure 5).



**Figure 5.** GDP per person employed (constant 1990 PPP \$). Visegrad Group vs. EU-15  
Source: World bank, 2016.

Unfortunately the picture do not change for the better when other macro indicators of V-4 of the sectoral character such as: expenditures on education as share in government expenditures, R&D expenditures to GDP ratio and, finally, the patents applications level to population ratio are confronted with similar indicators for EU-15 countries.

As indicated by the data depicted on Graph 6 in all V-4 the expenditures on education as share in governments expenditures total have been lower than in EU-15 countries in the period analyzed with periodical exception with respect to Poland but only for a few years in that period because in recent years the ratio in Poland has declined again to reach the below the EU-15 level again (Figure 6).

Similar negative tendency could be observed with respect to R&D expenditures levels in relation to GDP in V-4 countries as compared to EU-15 (Figure 7). The V-4 levels are 2–3 lower compared to those in EU-15. In recent 3–4 years the V-4 countries have increased the expenditures substantially nevertheless the level remained lower and not reaching even 50% of the EU-15 level with the Czech republic as being the only exception to that rule (Figure 7).

As the result of the low level of expenditures on educations as well as the low R&D expenditures to GDP ratio it comes as of no surprise that that level of patent application in V-4 – 4 countries has been substantially lower compared to EU-15 just as well. What is worrisome is the fact that in all V-4 countries with excep-

tion of Poland the level is not only significantly lower compared to EU-15 but there is no tendency observed for any change during the whole period analyzed (Figure 8).

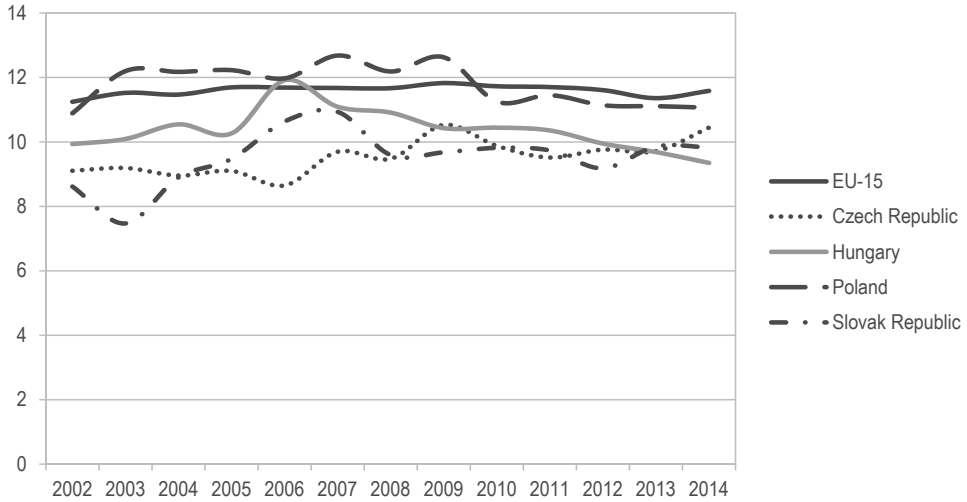


Figure 6. Expenditure on education as % of total government expenditures (%). Visegrad Group vs. EU-15

Source: World Bank, 2016.

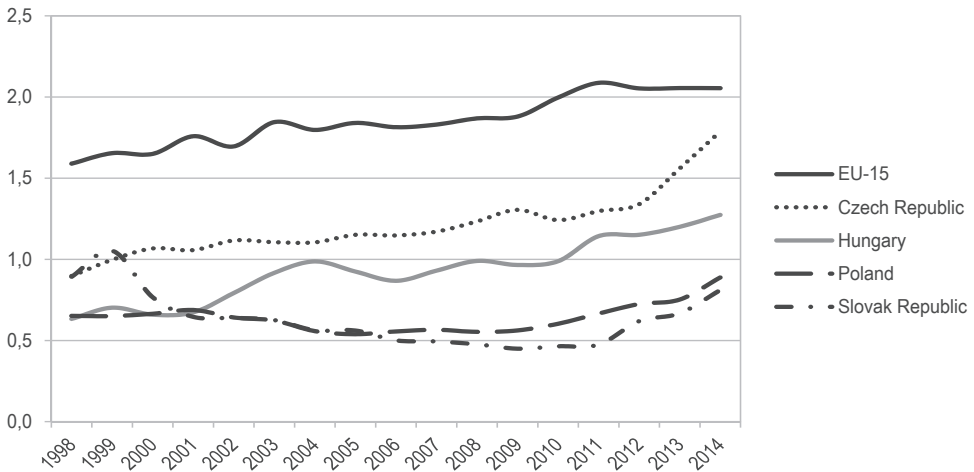
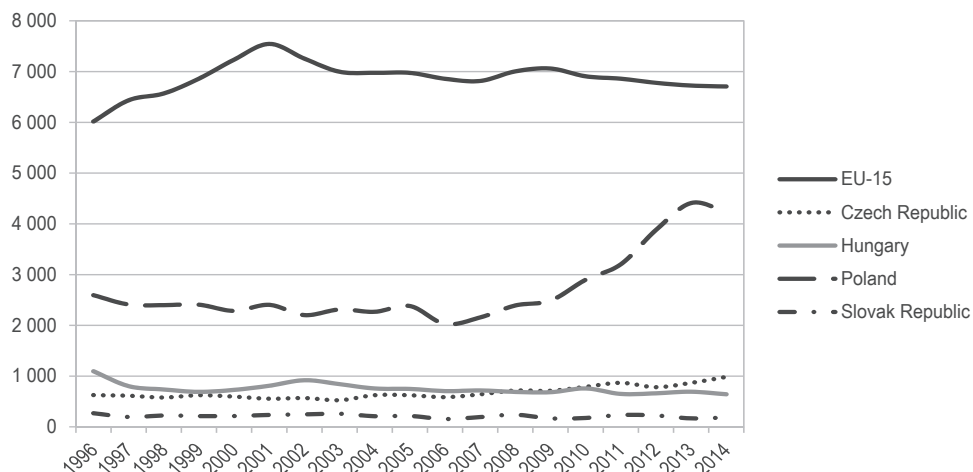


Figure 7. Research and development expenditure (% of GDP). Visegrad group vs. EU-15

Source: World bank, 2016.



**Figure 8.** Patent applications, residents. Visegrad group vs. EU-15

Source: World bank, 2016.

To broaden the scope of measures aiming at assessing competitive position of V-4 vis-a-vis EU-15 one should add such indicators of growth and competitiveness determinants such as friendliness of institutional environment for business. As indicated by data depicted in Tables 3 below the indexes for V-4 are lower compared to EU-15 on both accounts. Although both groups of countries have improved their positions and some of them like Poland has done it in an impressive way, yet all V-4 countries have gotten lower score compared to EU-15 average (Table 3). This confirms EU-15 superiority over countries of the V-4 group in the analyzed period.

**Table 3.** Changes in ranking positions of countries as depicted in „Easy of doing business reports” of World Bank in 2007–2015 (lower-better)

	2007	2015	Delta
EU-15	32	26	6
Poland	75	25	50
Slovakia	36	29	7
Hungary	66	42	24
Czech Republic	52	36	16
V-4	57	33	24

Source: World Bank-Annual Report on „Easiness in doing business” in 2004–2015. Lower score means better position of a country in terms of friendliness to business.

### 3. Estimating international competitiveness of V-4 countries vis-a-vis EU-15 group in 2007–2014 as measured by RCA indexes confronted with current SITC – rev, 4 High Tech classification

In the next step of our research paper we would like analyze changes in export composition of both V-4 and EU-15 in 2007–2014 in order to find out whether the changes as reflected in changes of RCA indexes have indicated the countries movement towards improvement of export competitiveness or not. Since world demand pattern moves towards high tech goods rather than low tech goods over time we would like to find out whether V-4 and/or EU-15 have increased amount  $RCA > 1$  in high tech sectors or group of high tech goods or not. If a country or a group of countries does it, that may indicate the country's ability to follow the ever changing world demand pattern and point at her higher competitive position and /or when the tendency continues, it may also illustrate and confirm a country ability to compete internationally in the longer run. As indicated in our introduction, when we discussed methodological issues, the international competitiveness of any economy should be assessed best way by selecting a country export specializations as measured by Revealed Comparative Advantage or RCA index first, and secondly, confront it with export composition as grouped by technological content or value added.

As the first step in this process of this in-depth analyses we have to start by selecting  $RCA > 1$  in both in EU-15 and V-4 and, secondly, using EU Eurostat statistics, select from Standard International Trade classification – SITC the groups of goods, which are considered high tech because of the high R&D cost share content as % of the total value of the goods in question (see Table 4).

Table 4. High tech aggregation of products by SITC Rev.4 (see note below)

Group	Code	Title
Aerospace	(714-714.89-714.99)+	Aeroplane motors, excluding 714.89 and 714.99
	792.1+	Helicopters
	792.2+792.3+792.4+	Aeroplanes and other aircraft, mechanically-propelled (other than helicopters)
	792.5+	Spacecraft (including satellites) and spacecraft launch vehicles
	792.91+	Propellers and rotors and parts thereof
	792.93+	Undercarriages and parts thereof
	874.11	Direction finding compasses; other navigational instruments and appliances
Computers office	751.94+	Multifunction office machines, capable of connecting to a computer or a network
	751.95+	Other office machines, capable of connecting to computer or a network

Table 4. Continued.

Group	Code	Title
<b>Machines</b>	752+	Computers
	759.97	Parts and accessories of group 752
<b>Electronics-telecommunications</b>	763.31+	Sound recording or reproducing apparatus operated by coins, bank cards, etc.
	763.8+	Video apparatus
	(764-764.93-764.99)+	Telecommunications equipment, excluding 764.93 and 764.99
	772.2+	Printed circuits
	772.61+	Electrical boards and consoles < 1000V
	773.18+	Optical fibre cables
	776.25+	Microwave tubes
	776.27+	Other valves and tubes
	776.3+	Semiconductor devices
	776.4+	Electronic integrated circuits
	776.8+	Piezoelectric crystals
	898.44+	Optical media
898.46	Semiconductor media	
<b>Pharmacy</b>	541.3+	Antibiotics
	541.5+	Hormones and their derivatives
	541.6+	Glycosides, glands, antisera, vaccines
	542.1+	Medicaments containing antibiotics or derivatives thereof
	542.2	Medicaments containing hormones or other products of subgroup 541.5
<b>Scientific</b>	774+	Electrodiagnostic apparatus for medicine or surgery and radiological apparatus
	871+	Optical instruments and apparatus
	872.11+	Dental drill engines
<b>Instruments</b>	(874-874.11-874.2)+	Measuring instruments and apparatus, excluding 874.11, 874.2
	881.11+	Photographic cameras
	881.21+	Cinematographic cameras
	884.11+	Contact lenses
	884.19+	Optical fibres other than those of heading 773.1
	(899.6-899.65-899.69)	Orthopedic appliances, excluding 899.65, 899.69
<b>Electrical</b>	(778.6-778.61-778.66-778.69)+	Electrical capacitors, fixed, variable or adjustable, excluding 778.61, 778.66,
		778.69
<b>Machinery</b>	778.7+	Electrical machines, having individual functions
	778.84	Electric sound or visual signaling apparatus

Table 4. Continued.

Group	Code	Title
Chemistry	522.22+	Selenium, tellurium, phosphorus, arsenic and boron
	522.23+	Silicon
	522.29+	Calcium, strontium and barium
	522.69+	Other inorganic bases
	525+	Radioactive materials
	531+	Synthetic organic colouring matter and colour lakes
	574.33+	Polyethylene terephthalate
	591	Insecticides, disinfectants
Non-electrical	714.89+	Other gas turbines
	714.99+	Part of gas turbines
	718.7+	Nuclear reactors and parts thereof, fuel elements, etc.
	728.47+	Machinery and apparatus for isotopic separation
	731.1+	Machine-tools working by laser or other light or photon beam, etc
	731.31+	Horizontal lathes, numerically controlled
	731.35+	Other lathes, numerically controlled
	731.42+	Other drilling machines, numerically controlled
	731.44+	Other boring-milling machines, numerically controlled
	731.51+	Milling machines, knee-type, numerically controlled
Machinery	731.53+	Other milling machines, numerically controlled
	731.61+	Flat-surface grinding machines, numerically controlled
	731.63+	Other grinding machines, numerically controlled
	731.65+	Sharpening machines, numerically controlled
	733.12+	Bending, folding, straightening or flattening machines, numerically controlled
	733.14+	Shearing machines, numerically controlled
	733.16+	Punching machines, numerically controlled
	735.9+	Parts and accessories of 731 and 733
	737.33+	Machines and apparatus for resistance welding of metal, fully or partly automatic
	737.35	Machines and apparatus for arc welding of metal, fully or partly automatic
Armament	891	Arms and ammunition

Source: UNSTATS, 2016.

Note: High-technology trade is defined as exports and imports of products according to the Standard International Trade Classification (SITC – Rev. 4) as listed below. This list, based on the OECD definition, contains technical products of which the manufacturing involved a high intensity of R&D.



At the second step of our analyzes, that is after knowing SITC categories which are considered high tech, we shall confront them with our RCA,  $s > 1$  for V-4's and EU-15 and this way we could build tables containing the information with respect to their high tech exports during the time.

Table 5. RCA Poland

RCA in HIGH-TECH for Poland, 2007-2013							
	2007	2008	2009	2010	2011	2012	2013
Areocraft	0.19	0.25	0.55	0.82	0.76	0.79	0.86
Computer office machines	0.08	0.44	0.74	0.78	0.66	0.88	0.70
Electronics – Telecommunication	0.09	0.18	0.09	0.10	0.10	0.12	0.16
Pharmacy	0.15	0.12	0.12	0.14	0.13	0.18	0.18
Scientific instruments	0.18	0.22	0.19	0.38	0.26	0.25	0.50
Electrical machinery	0.23	0.57	0.16	0.16	0.18	0.16	0.18
Chemistry	0.34	0.33	0.33	0.36	0.40	0.43	0.45
Non electric machinery	0.43	0.44	0.33	0.29	0.31	0.52	0.64
Armament	<b>1.39</b>	<b>1.55</b>	<b>1.30</b>	0.94	0.29	0.25	0.42

Source: own calculations based on ComTrade, 2015.

Similar situation can be seen in Slovakia. Although, Slovakia cannot be considered as competitive according to used methodology in neither of high tech industries and don't show such outstanding results as Poland. Positive dynamic also can be observe in Computer office machines and Electronic–Telecommunication. Some kind of improvement also was seen in Scientific Instruments and Electric machinery. Yet none of the high tech categories has reached the RCA=1 level indicating very low competitiveness position of that country.

Table 6. RCA Slovakia

RCA in HIGH-TECH for Slovakia, 2007-2013							
	2007	2008	2009	2010	2011	2012	2013
Areocraft	0.02	0.01	0.08	0.07	0.02	0.04	0.01
Computer office machines	0.25	0.21	0.20	0.23	0.36	0.56	0.79
Electronics – Telecommunication	0.18	0.35	0.24	0.27	0.28	0.36	0.40
Pharmacy	0.12	0.09	0.07	0.08	0.10	0.06	0.07
Scientific instruments	0.14	0.19	0.13	0.21	0.15	0.21	0.28
Electrical machinery	0.21	0.51	0.26	0.23	0.30	0.29	0.37
Chemistry	0.14	0.15	0.18	0.14	0.10	0.11	0.12
Non electric machinery	0.38	0.40	0.30	0.36	0.45	0.43	0.49
Armament	0.86	0.42	0.78	0.66	0.65	0.56	0.58

Source: own calculations based on ComTrade, 2015.

The most outstanding results are shown by Hungary and Czech Republic. Both kept their positions and/or became competitive in 3 and 4 industries respectively. Positive dynamics can be also mentioned in several industries.

Table 7. RCA Czech Republic

RCA in HIGH-TECH for Czech Republic, 2007–2013							
	2007	2008	2009	2010	2011	2012	2013
Areocraft	0.41	0.32	0.58	0.37	0.34	0.30	0.36
Computer office machines	<b>2.08</b>	<b>2.10</b>	<b>2.01</b>	<b>2.28</b>	<b>2.71</b>	<b>3.58</b>	<b>2.96</b>
Electronics – Telecommunication	0.25	0.63	0.34	0.31	0.39	0.35	0.32
Pharmacy	0.22	0.23	0.24	0.25	0.25	0.22	0.25
Scientific instruments	0.37	0.39	0.37	0.59	0.43	0.42	0.76
Electrical machinery	<b>1.18</b>	<b>2.77</b>	<b>1.01</b>	<b>1.08</b>	<b>1.25</b>	<b>1.10</b>	<b>1.16</b>
Chemistry	0.25	0.21	0.24	0.25	0.26	0.29	0.29
Non electric machinery	<b>1.17</b>	<b>1.18</b>	<b>1.05</b>	<b>1.12</b>	<b>1.20</b>	<b>1.35</b>	<b>1.23</b>
Armament	<b>1.58</b>	<b>1.59</b>	<b>1.78</b>	<b>1.98</b>	<b>1.79</b>	<b>2.30</b>	<b>2.54</b>

Source: own calculations based on ComTrade, 2015.

Table 8. RCA EU-15

RCA in HIGH-TECH. EU-15, 2007–2013							
	2007	2008	2009	2010	2011	2012	2013
Areocraft	2.14	2.43	2.44	2.45	2.38	4.93	4.38
Computer office machines	<b>0.89</b>	<b>0.90</b>	<b>0.77</b>	<b>0.73</b>	<b>0.73</b>	<b>0.91</b>	<b>0.90</b>
Electronics – Telecommunication	<b>1.71</b>	<b>2.36</b>	<b>0.98</b>	<b>0.68</b>	<b>0.63</b>	<b>1.17</b>	<b>1.73</b>
Pharmacy	2.22	2.17	2.02	2.10	2.28	2.39	2.20
Scientific instruments	1.28	1.36	1.23	2.17	1.28	1.21	2.15
Electrical machinery	<b>0.77</b>	<b>0.66</b>	<b>0.68</b>	<b>0.65</b>	<b>0.66</b>	<b>0.62</b>	<b>0.60</b>
Chemistry	1.41	1.23	1.41	1.38	1.29	1.36	1.13
Non electric machinery	1.61	1.86	2.07	2.19	2.06	2.12	2.22
Armament	1.48	1.10	1.58	1.39	1.73	1.57	1.81

Source: own calculations based on ComTrade, 2015.

The slightly better RCA >1 for Hungary and the Czech Republic does not change the dismal picture of the V-4 countries as far as their international competitiveness position as measured by the RCA indexes.

As we can see from the data depicted in Table 10 the Visegrad group as total has only 1 category of goods which represent RCA > 1 thanks to the relatively good Czech and Hungarian export performance in this category. None of the

remaining group of high tech goods have been able to cross the  $RCA=1.1$  threshold (Table 10). What is more disturbing is the fact that at the same time of 2007–2013 the EU countries have been able to increase their international competitive position vis-a-vis V-4 countries in a significant way. As illustrated by the data depicted on Graph 10 below the gap between V-4 and EU-15 in 2007–2013 in high goods has not only been significant at that time but what is most worrisome is that it has increased in recent years in a rather dramatic way indicating some structural problem in innovations in the V-4 countries. This negative tendency indicates and/or suggests the source of the V-4 international competitiveness problems which in turn, requires further investigation and in-depth research into the subject matter which is beyond the scope of this article, however.

**Table 9. RCA Hungary**

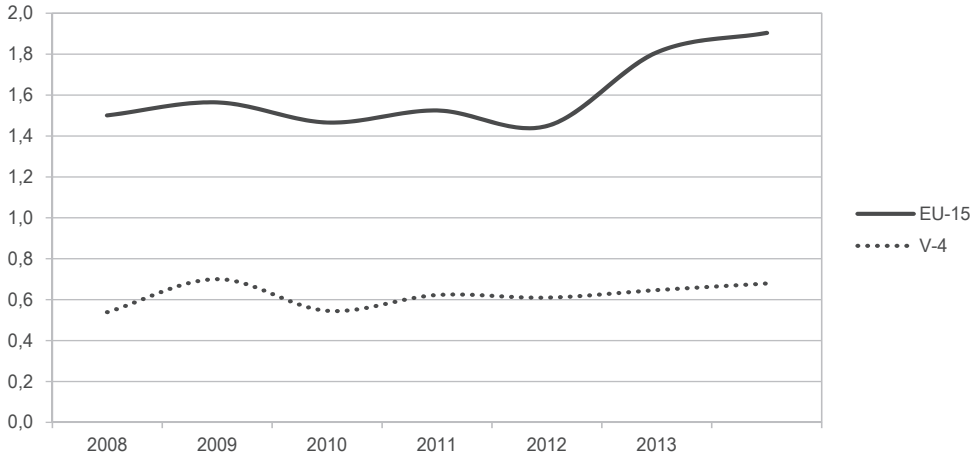
RCA in HIGH-TECH for Hungary, 2007–2013							
	2007	2008	2009	2010	2011	2012	2013
Areocraft	0.01	0.02	0.04	0.09	0.07	0.07	0.07
Computer office machines	<b>1.55</b>	<b>1.41</b>	<b>1.07</b>	<b>0.93</b>	<b>1.03</b>	<b>1.42</b>	<b>1.33</b>
Electronics – Telecommunication	0.80	1.59	0.89	0.85	0.87	0.58	0.49
Pharmacy	0.23	0.34	0.42	0.55	0.75	0.75	0.68
Scientific instruments	0.92	0.90	0.83	1.45	2.34	<b>1.05</b>	<b>1.96</b>
Electrical machinery	<b>1.01</b>	<b>2.59</b>	<b>1.12</b>	<b>1.11</b>	0.86	0.83	<b>1.04</b>
Chemistry	0.38	0.82	0.49	0.54	0.40	0.53	0.56
Non electric machinery	0.87	0.81	0.10	<b>1.02</b>	<b>1.14</b>	<b>1.43</b>	<b>1.34</b>
Armament	0.01	0.02	0.00	0.01	0.00	0.00	0.02

Source: own calculations based on ComTrade, 2015.

**Table 10. RCA Vysegrad**

RCA in HIGH-TECH for Vysegrad, 2007–2013							
	2007	2008	2009	2010	2011	2012	2013
Areocraft	0.19	0.19	0.39	0.56	0.37	0.37	0.42
Computer office machines	0.97	<b>1.06</b>	<b>1.06</b>	<b>1.12</b>	<b>1.25</b>	<b>1.67</b>	<b>1.42</b>
Electronics – Telecommunication	0.30	0.62	0.34	0.33	0.36	0.26	0.24
Pharmacy	0.29	0.30	0.29	0.32	0.37	0.36	0.35
Scientific instruments	0.40	0.42	0.37	0.65	0.71	0.45	0.82
Electrical machinery	0.66	1.59	0.61	0.62	0.64	0.58	0.64
Chemistry	0.30	0.37	0.32	0.34	0.32	0.36	0.38
Non electric machinery	0.75	0.74	0.50	0.71	0.78	0.94	0.92
Armament	0.99	<b>1.01</b>	<b>1.03</b>	0.96	0.70	0.82	0.93

Source: own calculations based on ComTrade, 2015.



**Figure 9.** RCA in HIGH TECH export. V4 vs. EU-15. 2007–2013

Source: own calculations based on COMTRADE, 2015.

## Conclusions

The observed and analyzed data and tendencies related to macro performance and international competitiveness position changes of countries of V-4 and EU-15 in the 2007–2014 or after the financial crisis period, indicate different outcomes of the two group of countries on analyzed accounts.

On the first account that is on macro performance as measured by magic quadrangle indicators such as: GDP growth, inflation and unemployment levels and its changes, both V-4 and EU-15 have not shown a difference of significance which could prove superiority of either group because the vectors of change of the analyzed indicators were having opposite vectors of change compensating significance of each other i.e., faster GDP growth of the V-4 countries and but their higher unemployment and/or inflation rates. As the result, the change in macro indicators of the two groups over the analyzed period does not provide any evidence which group has performed better way in that period. The only macro indicator from magic quadrangle group, that is balance of payment, illustrated EU significant advantage as reflected in big balances surpluses of EU-15 as opposed to permanent deficits of all V-4 countries with only some improvements in the last 2–3 years in the analyzed period. As for other macro indicators of sectoral character such as the role of education or R&D share in GDP or the patent levels to population in both V-4 and EU-15 have shown either small improvements or no improvements at all supporting view that both the level as well as improvements of V-4 on these account have not been significant enough to improve the V-4 competitiveness position as suggested by the macro indicators.

Similar conclusions could be drawn when looking at and analyzing some micro indicators such as institutional setting for business as presented by the World Bank in its annual reports on „Doing business”. The V-4 ranking position has been improving steady, yet their average position is still well behind that of the EU-15 level.

On the second account, critical to our analyzes, that of measuring changes in international competitiveness of V-4 an EU-15 after the financial crisis by the measuring RCA indexes and their relation to the SITC Rev,4 classification for high tech goods one has to admit that V-4 competitive position has been weak during the analyzed period and even deteriorated significantly in recent 2–3 years. The detailed data on RCA indexes in V-4 countries with respect to high tech goods share in their export composition in 2007–2014 compounded with poor high education, R&D and patent ratios indicate clearly that the V-4 countries have been struggling with innovativeness problem during the time with no success in sight. At the same time the EU-15 countries have increased their respective  $RCA > 1$  indexes in high tech groups of goods of their exports indicating improvement of their competitiveness position vis-a-vis V-4 in the post crisis period.

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## Annex

**Table 1.** High tech<sup>4</sup> aggregation of products by SITC Rev.4

**Table 2.** SITC Rev.3 – United Nations Statistics Division

- 0 – Food and live animals
- 00 – Live animals other than animals of division 03
- 01 – Meat and meat preparations
- 02 – Dairy products and birds' eggs
- 03 – Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof
- 04 – Cereals and cereal preparations
- 05 – Vegetables and fruit
- 06 – Sugars, sugar preparations and honey
- 07 – Coffee, tea, cocoa, spices, and manufactures thereof
- 08 – Feeding stuff for animals (not including unmilled cereals)
- 09 – Miscellaneous edible products and preparations
  - 1 – Beverages and tobacco
- 11 – Beverages
- 12 – Tobacco and tobacco manufactures
  - 2 – Crude materials, inedible, except fuels
- 21 – Hides, skins and furskins, raw
- 22 – Oil-seeds and oleaginous fruits
- 23 – Crude rubber (including synthetic and reclaimed)

<sup>4</sup>High-technology trade is defined as exports and imports of products according the Standard International Trade Classification (SITC – Rev. 4) as listed below. This list, based on the OECD definition, contains technical products.

- 24 – Cork and wood
- 25 – Pulp and waste paper
- 26 – Textile fibres (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric)
- 27 – Crude fertilizers, other than those of Division 56, and crude minerals (excluding coal, petroleum and precious stones)
- 28 – Metalliferous ores and metal scrap
- 29 – Crude animal and vegetable materials, n.e.s.
  - 3 – Mineral fuels, lubricants and related materials
- 32 – Coal, coke and briquettes
- 33 – Petroleum, petroleum products and related materials
- 34 – Gas, natural and manufactured
- 35 – Electric current
  - 4 – Animal and vegetable oils, fats and waxes
- 41 – Animal oils and fats
- 42 – Fixed vegetable fats and oils, crude, refined or fractionated
- 43 – Animal or vegetable fats and oils, processed; waxes of animal or vegetable origin; inedible mixtures or preparations of animal or vegetable fats or oils, n.e.s.
  - 5 – Chemicals and related products, n.e.s.
- 51 – Organic chemicals
- 52 – Inorganic chemicals
- 53 – Dyeing, tanning and colouring materials
- 54 – Medicinal and pharmaceutical products
- 55 – Essential oils and resinoids and perfume materials; toilet, polishing and cleansing preparations
- 56 – Fertilizers (other than those of group 272)
- 57 – Plastics in primary forms
- 58 – Plastics in non-primary forms
- 59 – Chemical materials and products, n.e.s.
  - 6 – Manufactured goods classified chiefly by material
- 61 – Leather, leather manufactures, n.e.s., and dressed furskins
- 62 – Rubber manufactures, n.e.s.
- 63 – Cork and wood manufactures (excluding furniture)
- 64 – Paper, paperboard and articles of paper pulp, of paper or of paperboard
- 65 – Textile yarn, fabrics, made-up articles, n.e.s., and related products
- 66 – Non-metallic mineral manufactures, n.e.s.
- 67 – Iron and steel
- 68 – Non-ferrous metals
- 69 – Manufactures of metals, n.e.s.
  - 7 – Machinery and transport equipment

- 71 – Power-generating machinery and equipment
- 72 – Machinery specialized for particular industries
- 73 – Metalworking machinery
- 74 – General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.
- 75 – Office machines and automatic data-processing machines
- 76 – Telecommunications and sound-recording and reproducing apparatus and equipment
- 77 – Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including non-electrical counterparts, n.e.s., of electrical household-type equipment)
- 78 – Road vehicles (including air-cushion vehicles)
- 79 – Other transport equipment
  - 8 – Miscellaneous manufactured articles
- 81 – Prefabricated buildings; sanitary, plumbing, heating and lighting fixtures and fittings, n.e.s.
- 82 – Furniture and parts thereof; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings
- 83 – Travel goods, handbags and similar containers
- 84 – Articles of apparel and clothing accessories
- 85 – Footwear
- 87 – Professional, scientific and controlling instruments and apparatus, n.e.s.
- 88 – Photographic apparatus, equipment and supplies and optical goods, n.e.s.; watches and clocks
- 89 – Miscellaneous manufactured articles, n.e.s.
  - 9 – Commodities and transactions not classified elsewhere in the SITC
- 91 – Postal packages not classified according to kind
- 93 – Special transactions and commodities not classified according to kind
- 96 – Coin (other than gold coin), not being legal tender
- 97 – Gold, non-monetary (excluding gold ores and concentrates)
  - I – Gold, monetary
  - II – Gold coin and current coin