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Analysis of High Technology of the European Union Countries

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Abstract

The purpose of this publication is to analyse of high technology of the European Union (EU) with EFTA countries. To analyse the impact of high technology production and trade are both within the EU and globally. The EU appears to be successful in this area, as evidenced by the high volumes of high technology production exports. Deep analysis, however, shows that much is not right here. As a rule, these groups of goods in foreign trade are negative, which means a greater cash outflow than exporting to come. The differences between big countries are also large and at times contradictory. Just as the entire EU economy and foreign trade has been a major engine of Germany. However, medium-sized countries such as the Netherlands, the Nordic countries, the Czech Republic, Poland and the Baltic, among the EU newcomers, are also successful. The challenge for the EU is to achieve a positive trade balance as a whole, as well as for individual high technology production commodity groups. At the same time, we must not forget the growing global competition. As one of the Europe super power the United Kingdom leaves (Brexit) the EU, it is important to analyze how it affects the EU economy. Which strongly affects not only the UK, but also whole the EU economy and politics. This publication aim is to analyze the dynamics of high technology key indicators: research expenditure share of GDP, number enterprises in high-tech sectors, turnover, production value, value added, gross operating surplus and trade. For comparison, we gave a brief overview of the high-technology manufacturing and knowledge-intensive high-technology sectors. In order to assess the economic strength of the UK, we will conduct a comparative analysis with other major the EU powers. It shows how much the EU manufacturing loses as the UK leaves. The analysis showed that both the EU and the UK would lose a great deal with this departure, not only in manufacturing and the economy, but also in other areas of life related to it. Development of high technology of the EU has been uneven and partially ineffective. This analysis covers period of economic development until the corona virus (COVID-19) up to 2020, which caused the economic recession in most countries. High technology makes it possible to quickly exit the COVID-19 caused by the economic crisis.

Keywords

European Union, High Technology, Production, Trade, Its Influence, Corona Virus, Economic Recession

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1. Introduction

As industry has been the basis of their wealth and high technology is one of the most important indicators of its effectiveness. Then we will analyse the main indicators of industrial, here he high technology development.

We analyse the competitiveness of the EU as a whole and intra-EU Member States on the other. On the one hand, China, India and other former developing countries are strengthening their economies and, on the other, the exit of the strong industrialized country, the UK from the EU is weakening the EU.

High technologies are very sophisticated technologies, often including electronics and robotics, used in production and other processes [1]. Unlike “low technologies” - simple technologies that have been used for centuries, limited to the

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production of basic necessities [2]. The transition to the use of high technologies and their corresponding technology is the most important link in the scientific and technological revolution at the present stage. The most high-tech industries are usually referred to *high technologies*.

The word high technology is a loan translation (English high technology, high-tech). It is therefore used as a synonym for Anglicism "high-tech". The cutting-edge technology contrasts with the basic technology (low-tech); Adapted technologies are sometimes the areas in between, but in the real sense it means “adapting” knowledge. [3; 4]

High tech manufacturing is an extremely wide and poorly-defined segment of the modern manufacturing industry. Exactly what products are considered high tech is a vague concept left up to marketing departments. By its broadest definition, high tech manufacturing involves circuit boards or advanced chemical manufacturing. This makes everything from cancer medicine and laptops to coffee makers and aspirin high tech. Some industries and economists have attempted to narrow the classification down but have met with little success. [5]

Manufacturing is the production of goods for use or sale using labour and machines, tools, chemical and biological processing, or formulation. The term may refer to a range of human activity, from handicraft to high tech, but is most commonly applied to industrial production, in which raw materials are transformed into finished goods on a large scale. [5 - 7]

Engineers work is the basis for effective industrial production. The competence of engineers and their creative achievements are the basis of efficient industrial production.

2. Methodology and Theoretical Bases

Classification of economic activities is by NACE of Eurostat [9-10]. *NACE* is the nomenclature of economic activities in the EU. NACE Rev. 2 is to be used, in general, for statistics referring to economic activities performed as from 1 January 2008 onwards.

Source data based on structural business statistics 24 *activities* of the EU. [11] *Statistical classification of economic activities in the European Community*, abbreviated as NACE, is the nomenclature of economic activities in the EU. This article presents an overview of the EU manufacturing sector, which is included in NACE Rev. 2 Section C. [12]

The methodology is based on the international organizations Eurostat [9-13], CIA [14], WB [15] and OECD [16].

GDP is an indicator for a nation´s economic situation and a measure of the economic activity. It reflects the total value of all goods and services produced. Expressing GDP in *PPS (purchasing power standards*) eliminates differences in price levels between countries, and calculations on a per head basis allows for the comparison of economies significantly different in absolute size. [49]

GDP *purchasing power parity* (PPP) compares the GDP or value of all final goods and services produced within a nation in a given year. A nation's GDP at PPP exchange rates is the sum value of all goods and services produced in the country valued at prices prevailing in the United States. [14]

GDP per capita is calculated by dividing GDP by midyear population. GDP is the total market value of all final goods and services produced in a country in a given year. In Nominal method, market exchange rates are used for conversion. [15]

This methodology of World Bank and OECD gives a more accurate picture of the changes in the economy (GDP), as currency fluctuations are eliminated here.

Production value measures the amount actually produced by the unit, based on sales, including changes in stocks and the resale of goods and services. The production value is defined as turnover, plus or minus the changes in stocks of finished products, work in progress and goods and services purchased for resale, minus the purchases of goods and services for resale, plus capitalised production, plus other operating income (excluding subsidies). Income and expenditure classified as financial or extra-ordinary in company accounts is excluded from production value. [50]

Value added represents the difference between the value of what is produced and intermediate consumption entering the production, less subsidies on production and costs, taxes and levies. [53]

Turnover is the total of all sales (excluding VAT) of goods and services carried out by the enterprises of a given sector during the reference period. [13]

Purchases of goods and services include the value of all goods and services purchased during the reference period for resale or consumption in the production process, excluding capital goods the consumption of which is registered as consumption of fixed capital. The goods and services concerned may be either resold with or without further transformation, completely used up in the production process or, finally, be stocked. Included in these purchases are the materials that enter directly into the goods produced (raw materials, intermediary products, components), plus non-capitalised small tools and equipment. Included is value of ancillary materials (lubricants, water, packaging, maintenance and repair

materials, offices materials) as well as energy products. Included in this variable are the purchases of materials made for the production of capital goods by the unit. [60]

Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. R&D expenditures include all expenditures for R&D performed within the business enterprise sector (BERD) on the national territory during a given period, regardless of the source of funds. R&D expenditure in BERD is shown as a percentage of GDP (R&D intensity). [56]

Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned. Head count (HC) data measure the total number of researchers who are mainly or partly employed on R&D. [57]

The theoretical bases of key indicators have been brought in more detail in the author book [6 - 8], in authors' earlier works [32 - 48] and in the works of other authors [17 – 31].

All figures are the authors' illustration

3. Development of GDP of the EEA Countries

For background let's look at what had developed by the EEA (EU+EFTA) economy (GDP) 20 years at market prices and PPS of countries in EUR and USD.

GDP at Current Prices

As follows is analysis of GDP at current prices.

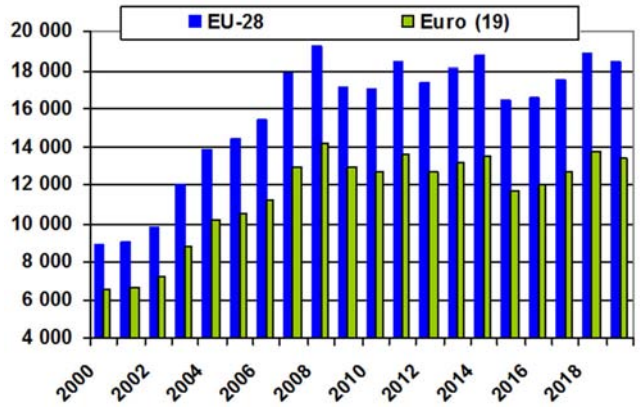

Figure 1. Gross domestic product at market prices of the EU. Current prices, billion US dollars [52].

Figure 1 shows the EU-28 economy (GDP) increasing smooth cyclical developments. Between 2000 and 2018 GDP grew 2.100 times, but record year 2008 – 19,240 bn USD. In Euros the picture was different: grew was 2.015 times and record year was 2018 – 14,1509 bn USD. It shows that the EU economy faced major challenges after the crisis in 2009, with 2018 GDP still not exceeding record levels in 2008. In 2015 and 2016, however, GDP was lower than in 2009 and 2010. This means: EU-28 and Euro area 19 have developed under the same laws of the economy. 2019 was worse than the previous 2018 year.

Five major the EU countries GDP exceeds one trillion USD. These countries gave up 69.9% of total EU-28 GDP and without the UK 54.8%. Shares of GDP were: Germany 21.3%; the UK 15.1%; France 14.8%; Italy 14.0% and Spain 7.6%.

Figures 2 and 3 shows a complex 6-degree polynomial, where R^2 is not very high. GDP polynomials are usually much simpler and R^2 is 0.9 larger [32 - 33]. This indicates an unstable economy of the UK.

They had two major periods of decline during the period under analysis, that is, in this century. Between of 2007 - 2009 the GDP declined 680 million USD or nearly a quarter (22%), and from 2014 to 2017 of 379 million USD or about one eighth (12.5%). The 2007 level has not yet been reached in 2018, missing a quarter of a trillion or 8.55%. Other super countries also had smaller fluctuations in GDP. Apart from Germany, their record level in 2018 was not reached.

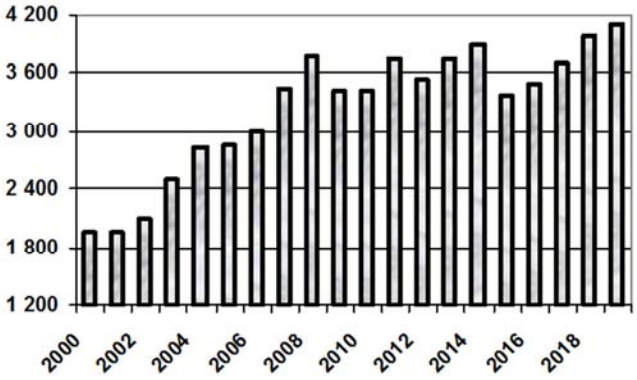

Figure 2. GDP at market prices of Germany. Current prices, billion USD [52].

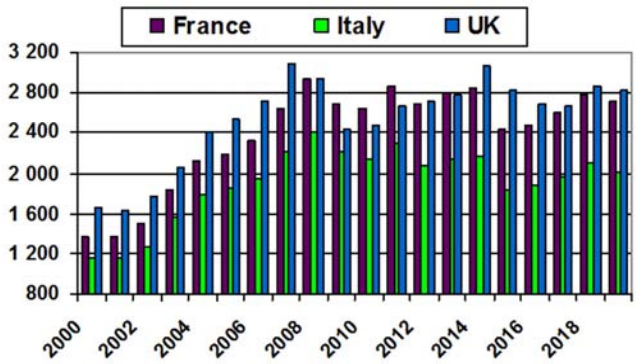

Figure 3. GDP at market prices of the UK, France and Italy. Current prices, billion USD [52].

Table 1. GDP at current prices, billion euros [51].

	2005	2008	2009	2011	2017	2018	2019
Germany	2300	2562	2460	2703	3277	3356	3449
Spain	930	1116	1079	1070	1166	1204	1245
France	1771	1992	1939	2059	2292	2360	2426
Italy	1489	1632	1572	1637	1724	1771	1790
UK	2027	1984	1716	1913	2360	2420	2523

Table 2. Development of GDP, bn current USD [52].

	2018	2019	2020	2021	2022	2023	2024
France	2,780	2,707	2,772	2,876	2,984	3,094	3,215
Germany	3,951	3,863	3,982	4,159	4,323	4,491	4,675
Italy	2,076	1,989	2,014	2,070	2,126	2,182	2,246

The IMF forecasts that also in 2019 super countries below 2018 and France above 2018 in 2021 and Italy only in 2022. IMF predicts that also in 2019 super countries below 2018 and France above 2018 in 2021 and Italy only in 2022.

Growth rate of GDP in 2018 was in EU-27 2.1%, in 2019 in it was in EU-27 1.6%, in Germany 0.6%, France 1.5%, Italy 0.3%, Spain 2.0% and UK 1.3%.

Based on current prices and exchange rates of the euro the EU is still low superiority in front the U. S. Significantly, only China was considerably larger. [33]

For global analyse we look GDP by purchasing power parity PPP (PPS).

Table 3. GDP at market prices, current prices, billion PPS [49].

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Germany	2,453	2,293	2,437	2,576	2,636	2,666	2,807	2,924	2,976	3,062	3,147	3,186
Spain	1,208	1,131	1,129	1,123	1,121	1,111,	1,149	1,218	1,238	1,288	1,316	1,364
France	1,785	1,706	1,786	1,845	1,870	1,916	1,963	2,043	2,046	2,086	2,158	2,278
Italy	1,651	1,555	1,594	1,639	1,642	1,607	1,622	1,684	1,729	1,761	1,799	1,836
UK	1,789	1,658	1,750	1,774	1,844	1,881	1,966	2,084	2,069	2,114	2,164	2,221

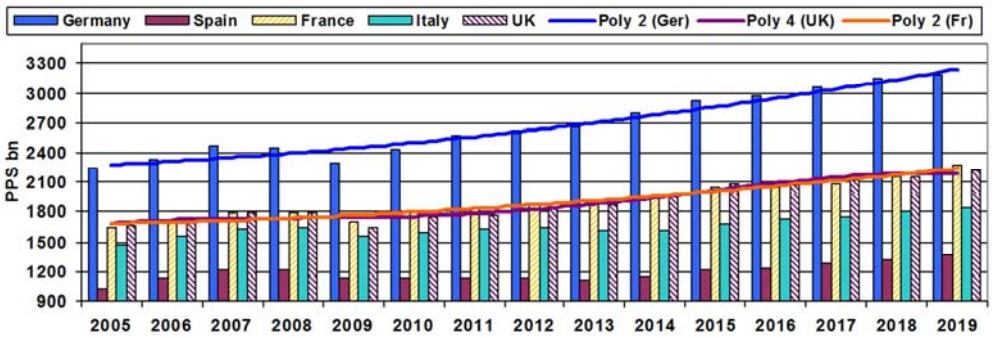

Figure 4. GDP at market prices, current prices, billion PPS [49].

Largest GDP by current and by *PPS* prices was Germany. It is by GDP (PPP) 1.5 times stronger than the UK. In the years 2007-2014 France was stronger than the UK, but the difference UK and France in 2015 was 59 million euros (0.003%) and in 2016 = 39.33 billion euros (1.902%). The UK percentage of EU28 total current prices was 13.8%. [33]

According to GDP by PPS, the UK has already exceeded 2007 levels on 2012. GDP by PPS has led to a steady increase in the UK economy and in 2016 France has passed, with France falling from 2007 to 2015. The UK GDP by PPS is from Germany only 69.4%. The UK share of GDP by PPS was also 13.8% in EU-28 on 2016.

While in the years 2008 - 2013 France was stronger than in the UK economy (PPS), with UK GDP accounted for only 75.5% from the Germany.

Relatively simple theoretical trend lines (2nd and 4th degree polynomials), which are very high R^2 indicate the period 2005-2018 both in Germany, France and the UK relative stable development of the economy, despite the 2009 downturn. [33] It was in 2018 largest by current prices in Germany, 3344 billion; in UK, 2419 bn; France, 2353 bn and in Italy 1765 bn EUR. Largest by PPS prices was in Germany, 3386 billion; in UK, 2390 bn; in France, 2349 bn; in Italy 1754 bn and in Spain, 1207 bn PPS.

Germany by GDP (PPS) is 1.5 times stronger than the UK and France. In the years 2007-2014 France was stronger than the UK, but the difference in current prices between UK (2641 bn) and France (2198 bn) in 2015 was 443 bn euros (16.77%) and in 2016 = 201 bn euros (8.25%). From 2015 by PPS and by current prices the UK was stronger France.

France, like Germany, has developed relatively stable GDP, characterized by simple theoretical trend lines (2nd degree polynomials), which are very high R^2. Theoretical trend lines (PPS) of Germany and France run in parallel, but the difference was only 597 bn in 2005, but already 1037 bn in 2018. France only topped Germany 2005 level in 2017. Germany's level of GDP was in the EU (28) at 29.8% and it was 2.5 times highest then Italy and France, and over 2.8 times highest then the UK level.

GDP per capita

Table 4. GDP current prices, euro per capita [51].

	2005	2008	2009	2017	2018	2019
Germany	28300	31700	30600	34440	40480	41510
Spain	21300	24300	23300	24970	25770	26430
France	28100	31000	30000	34250	35100	35960
Italy	25600	27600	26400	28690	29280	29660
UK	33600	31900	27600	35730	36440	37770

In 2017 was GDP *per capita* in Germany 39,600; Spain 25,100; France 34,100; Italy 28,500 and the UK 35,300 euro. In 2015 it was in the UK 40,000 euro.

In 2018 these were in Germany 40,340; in Spain 25,730; in France 34,980; in Italy 29,220 and in UK 36,410 euro. In the case of the UK GDP per capita was the largest in the years 2005 - 2008 and in 2015. In other years, Germany was superior to the great powers. GDP per capita of UK is larger than France, Italy and Spain, but less than Germany, other Central European and Nordic countries; 1.6 times smaller than Ireland. The average of the new EU member states and the EU-28 (29.100) GDP per capita is lower than the UK. The UK was ranked 10th in the 2016 EU ranking. [49]

In 2018 were GDP per capita in current prices in Germany 40,900; in Spain 25,800; in France 35,100; in Italy 29,000 and in UK 36,000 euro. UK GDP per capita was barely larger than France. In 2018 GDP per capita of the UK decreased compared to 2015 by 4000 euros or 10%. [12]

GDP per capita of UK (36,500) is larger than France, Italy and Spain, but less than Germany, other Central European and Nordic countries; 1.6 times smaller than Ireland. The average of the new EU member states and the EU-28 (29.300) GDP per capita is lower than the UK. The UK was ranked 10th in the EU ranking.

In the case of the EU great powers, the UK GDP per capita was the largest in the years 2005 - 2008 and 2015. In 2015 was GDP per capita in UK 40,000 euro. On other years, Germany was superior to the great powers.

Table 5. Nom GDP per capita ($) [52].

No	Country	2017	2018	2019
1	Luxemburg	105,863.2	113,954.4	115,203
2	Switzerland	80,637.4	83,583.0	85,157
3	Norway	75,389.5	82,372.4	82,773
5	Iceland	70,248.3	75,699.6	79,271
6	Ireland	68,710.8	75,192.3	77,160
10	Denmark	56,630.6	61,227.0	62,041
12	Sweden	52,925.1	53,867.2	54,135
13	Netherlands	48,555.4	52,931.2	54,129
14	Austria	47,347.4	51,707.6	52,474
16	Finland	45,927.5	50,068.1	50,879
17	Germany	44,769.2	48,669.6	49,692
19	Belgium	43,488.5	46,978.7	47,532
21	France	39,932.7	42,930.8	43,500
22	UK	39,800.3	42,260.9	42,036
27	Italy	31,997.0	34,349.2	34,784
33	Spain	28,358.8	31,059.5	31,906
36	Slovenia	23,654.4	26,586.1	27,507
41	Portugal	21,159.0	23,175.8	23,731
42	Czechia	20,401.6	23,085.2	24,938
43	Estonia	19,735.4	22,416.7	23,654
44	Greece	18,637.3	20,311.0	20,930

For comparison, nom GDP per capita: United States (8th) - 65,062 (it was 5.5 times to world); Russia (68th) 11,461 and China (73th) 8,643.1 USD.

Table 6. Nominal GDP per capita ($), IMF [65].

Country	2019	Pos	2020	Pos
Luxembourg	115,839	1	109,602	1
Switzerland	82,484	2	81,867	2
Ireland	80,504	3	79,669	3
Norway	75,294	5	67,989	4
USA	65,254	7	63,051	5
Denmark	59,770	10	58,439	7
Iceland	67,857	6	57,189	8
Netherlands	52,646	12	51,290	11
Sweden	51,404	13	50,339	12
Austria	50,380	14	48,634	13
Finland	48,810	15	48,461	14
Germany	46,473	18	45,466	15
Belgium	46,237	20	43,814	17
France	41,897	23	39,257	21
UK	42,379	22	39,229	22
Japan	40,256	25	39,048	23
Italy	33,159	28	30,657	27
South Korea	31,846	30	30,644	28
Malta	30,374	31	28,469	31
Spain	29,993	32	26,832	33
Cyprus	28,049	35	26,240	34
Slovenia	25,992	37	25,039	35
Estonia	23,758	40	22,986	37
Czech Rep	23,539	41	22,627	39
Portugal	23,132	43	21,608	41
Lithuania	19,482	45	19,883	43
Slovak Rep	19,344	46	18,669	45
Greece	19,570	44	18,168	46
Latvia	17,772	50	17,230	47
Hungary	16,470	54	15,373	50
Poland	15,601	58	15,304	52
Croatia	14,853	60	14,033	58
Romania	12,887	62	12,813	59
China	10,522	69	10,839	64
Russia	11,601	65	9,972	66
Bulgaria	9,772	72	9,826	67
World	11,557		10,954	

Nominal GDP per capita in eight countries was five times the world average, wherein just above was less than the China (in 2020 + $ 317) and Russia (-1629 $). All EU countries

exceeded the EU average, except Bulgaria. 63 countries were above average. The poorest economy, South Sudan, would be only 2.4% of the global nominal GDP per capita.

At the same time, this *IMF assessment* [65], which was carried out just before the end of the year, also shows the impact of the corona virus on the world's countries, including the most successful ones.

Out of 193 economies, GDP (nominal) per capita of the 29 economies would increase, and 164 economies would decrease in 2020 compared to 2019. They were successful China PR, Taiwan (Province of China), Bulgaria, Lithuania and some other countries.

International trade of the EU

Total international the EU trade = intra trade + extra trade.

Table 7. Exports and imports of goods and services of EEA, million euro, 2018 [55].

2018	Exports	Imports
Belgium	379,699.6	380,449.9
Germany	1,585,770.0	1,379,711.0
Ireland	396,383.2	288,993.4
Spain	422,170.0	389,547.0
France	737,399.0	755,600.0
Italy	555,285.7	511,166.2
Netherlands	652,685.0	567,613.0
Austria	215,057.0	200,702.9
Poland	275,928.9	258,872.2
Sweden	215,755.3	203,971.7
UK	742,026.2	775,694.9
Switzerland	394,798.5	321,807.9

Exports and imports of goods and services of German have grown to over 1.5 trillion, which is twice as much as in subsequent UK and France. It is also remarkably high in 4th place the small Netherlands 2/3 trillion euros.

Table 8. International trade by SITC product group of the EU, million EUR, 2018 [55].

2018	Export	Import	TB
Belgium	394,890.3	381,801.2	13,089.1
Bulgaria	28,095.7	32,104.7	-4,009.0
Czechia	171,260.2	156,457.5	14,802.7
Denmark	92,926.3	86,814.5	6,111.9
Germany	1,320,732.4	1,087,431.3	233,301.1
Estonia	14,424.3	16,228.2	-1,803.8
Ireland	139,831.2	91,560.2	48,271.0
Greece	33,451.4	54,061.0	-20,609.6
Spain	293,458.8	330,635.8	-37,177.1
France	492,583.7	568,339.3	-75,755.7
Croatia	14,750.5	23,886.7	-9,136.2
Italy	465,325.4	426,045.7	39,279.7
Cyprus	4,251.7	9,166.4	-4,914.8
Latvia	13,675.7	16,696.2	-3,020.5
Lithuania	28,271.0	30,942.6	-2,671.6
Luxembourg	13,824.9	20,344.7	-6,519.8
Hungary	106,498.4	103,057.4	3,441.1
Malta	2,551.9	5,357.5	-2,805.6
Netherlands	615,600.7	546,826.7	68,773.9
Austria	156,428.8	164,007.6	-7,578.8
Poland	223,213.1	227,796.4	-4,583.2
Portugal	57,806.5	75,363.9	-17,557.4
Romania	67,424.5	82,828.8	-15,404.3
Slovenia	37,423.0	35,803.3	1,619.8
Slovakia	79,136.9	78,727.4	409.5
Finland	64,235.8	66,577.0	-2,341.2
Sweden	140,512.8	144,473.1	-3,960.2
UK	412,055.5	570,546.8	-158,491.3

While the export of EU goods was 885.3 bn in 2002, then in 2018 it was already 1957.7 bn euros, an increase of 2.2 times. However, at the same time imports also increased from 936.9 bn to 1980.2 bn, that giving a TB deficit of 22.5 bn in 2018. However, between 2013 and 2017, the EU goods TB were still positive.

Table 9. International trade **goods**, *million USD, [55].*

2019	Export	Import	TB
Germany	1,330,414	1,102,153	228,261
Netherlands	633,057	567,890	65,167
France	509,948	584,682	-74,734
Italy	480,352	424,236	56,116
UK	419,800	619,672	-199,872
Spain	298,337	332,958	-34,621

At the same time, foreign trade volumes of all EU countries are growing, but not evenly.

Exports of German goods were 2.15 times higher than in second place the Netherlands, 2.7 times of France; 2.8 of Italy and 3.2 of UK.

By Eurostat for world comparison, in 2018 there was an export of goods: China 2112 bn; EU28 1958 bn and USA 1410 bn euro. Share in the world trade exports of EU was 15.6%, USA 11.2% and China 16.8%.

By comparison, the powerful nuclear power Russia exports was 382 bn (2016 = 273), which was at the same level as Mexico, Canada and Singapore, but lower than Netherlands and Belgium exports. [55]

By ITC in USD: China 2494 bn; USA 1666 bn and Germany 1557 bn USD. Share in the world trade exports of China was 12.9%, USA 8.6% and Germany 8.1%.[59]

Subsequently look their evolution, their dynamics.

Table 10. All countries of SITC06. Goods import of selected countries of the EU, in millions EUR [55].

	2005	2017	2018	2019
Belgium	256,169	362,586	385,151	381,963
Czechia	61,499	144,483	156,457	159,958
Germany	624,606	1029,652	1087,431	1102,153
Ireland	55,112	82,593	91,410	90,016
France	405,212	548,626	568,339	568,339
Italy	309,292	401,487	426,045	424,236
NL	292,438	508,372	546,826	567,890
UK	417,388	569,583	570,546	619,672

In these tables given countries is of decisive importance in

the international trade of the EU.

Imports from Germany are almost half as high as the next three countries. Successful imports make it possible to meet the growing demand of the wealthy population. The basis, however, is high exports and a positive trade balance. Netherlands (NL) goods imports in 2018 were almost the same as the UK and France. It promises also NL successful export.

Germany is also a firm leader in imports. It bought almost twice as much as, with a large TB deficit the UK and France. Almost the same volume of imports was with in surplus TB Netherlands (NL) and Italy as UK and France.

Table 11. Exports of goods, million EUR [55].

	2005	2017	2018	2019
Germany	780,415	1,281,946	1,320,732	1,330,414
NL	326,639.7	577,087.1	615,600.7	633,060
Ireland	88,142.0	121,759.7	139,831.2	151,478
Italy	299,923.4	449,129.0	465,325.4	480,352
Czechia	62,784.6	161,213.9	171,260.2	177,903
Belgium	268,788.8	380,787.1	394,890.3	399,183
UK	314,170.9	390,718.0	412,055.5	419,800
France	372,500.6	473,721.4	492,583.7	509,948
Greece	14,856.8	28,878.0	33,451.4	33,864

Germany has always been Europe's the largest exporter of goods and with the largest trade surplus. In second place is the small but successful Netherlands ahead of the major powers. However, Belgian exports are only 4.5% lower than the UK.

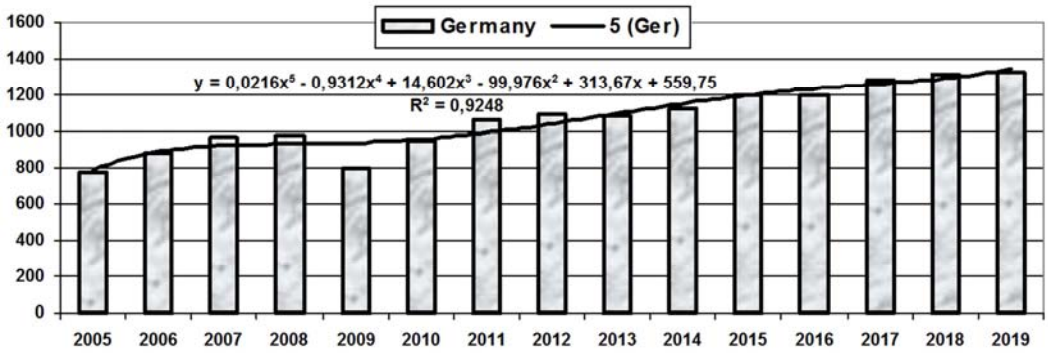

Figure 5. Goods export of Germany, bn EUR [55].

Germany $y = 0.0432x^5 - 1.6953x^4 + 24.369x^3 - 154.35x^2 + 438.6x + 472.96$; $R^2 = 0.9199$

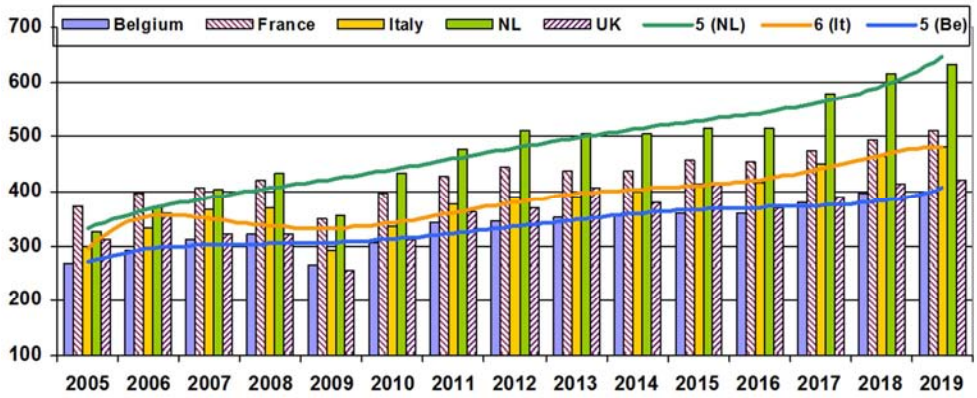

Figure 6. Goods export of superpower countries of the EU, bn EUR [55].

NL $y = 0.0226x^5 - 0.8118x^4 + 10.598x^3 - 61.282x^2 + 169.86x + 208.82$; $R^2 = 0.9292$
Italy $y = -0.0031x^6 + 0.1605x^5 - 3.2004x^4 + 31.229x^3 - 152.29x^2 + 341.47x + 76.521$; $R^2 = 0.8844$
Belgium $y = 0.0156x^5 - 0.5851x^4 + 7.9965x^3 - 47.947x^2 + 127.44x + 181.31$; $R^2 = 0.8747$

Table 12. All countries of the world SITC06: Total - all products. Trade balance in million EUR [55].

	2005	2008	2009	2010	2012	2014	2015	2016	2017	2018	2019
Belgium	12,619	3,761	11,618	12,457	5,301	13,860	19,201	16,925	18,359	13,089	17,220
Czechia	1,284.8	3,237	5,669	4,774	12,164	15,596	14,882	17,710	16,731	14,802	17,945
Germany	155,808	177,525	138,868	153,963	191,672	216,459	248,195	251,727	252,294	233,301	228,810
Ireland	33,029	28,389	38,158	40,953	37,616	29,385	41,808	44,851	39,165	48,271	61,462
France	-32,711	-68,367	-56,062	-65,854	-82,274	-71,445	-58,098	-60,023	-74,325	-75,755	-146,896
Italy	-9,368	-13,034	-5,875	-29,982	9,889	41,931	41,806	49,643	47,641	39,279	-25,366
NL	34,201	38,741	39,244	46,339	53,274	62,650	52,512	63,171	68,714	68,773	65,167
UK	-103,217	-126,200	-117,877	-131,525	-173,553	-139,373	-150,029	-205,185	-178,865	-158,491	-199,872

Table 13. Trade balance, million EUR, EEA, 2018 [55].

TB	+	TB	-
Germany	233,301.1	UK	-158,491.3
Netherlands	68,773.9	France	-75,755.7
Ireland	48,271.0	Spain	-37,177.1
Italy	39,279.7	Greece	-20,609.6
Czechia	14,802.7	Portugal	-17,557.4
Belgium	13,089.1	Romania	-15,404.3
Denmark	6,111.9	Croatia	-9,136.2
Hungary	3,441.1	Austria	-7,578.8
Slovenia	1,619.8	Luxembourg	-6,519.8
Slovakia	409.5	Cyprus	-4,914.8

In EEA with „+" TB were 10 and with „-" TB 18 stats.

The UK has always been the largest trade deficit in Europe. In 2016 deficit was 205 bn EUR.

Without UK the EU trade balance would be positive. The following are the 6 countries with larger positive (fat) and 3 negative trade balances.

In 2019 Euro area export was 1973 bn, import 1945 bn and TB +29.9 bn; Intra-EU28 export was 3586 bn, import 3512 bn and TB +73.4 bn; Extra-EU28 export was 2037 bn, import 2057 bn and TB -20.5 bn euro. [61]

In January to October 2020, euro area exports of goods to the rest of the world fell to €1744 bn (- 11.1%), and imports fell to €1564 bn (- 12.4%). As a result, the euro area recorded a surplus of €180.1 bn,

Intra-euro area trade fell to €1478.4 bn in Jan-Oct 2020 (-10.8%). In Jan to Oct 2020, extra-EU exports of goods fell to €1579.4 bn (-11.3%), and imports fell to €1417.2 bn (-13.0%). As a result, the EU recorded a surplus of €162.2 bn. Intra-EU trade fell to €2334.4 bn (-9.5%). [62]

High Technology of the Eu

Here we look at the impact of high technology manufacturing to economy of the EU. We will first observe the main quantitative indicators dynamics.

Table 14. R&D expenditure, million euro [59].

	2010	2015	2017	2018	2019
EU - 27	216,262	259,625	281,767	295,091	306,335
EA - 19	190,346	225,952	245,009	256,294	265,278
Germany	70,014	88,781	99,553	104,669	109,322
Spain	14,588	13,172	14,063	14,946	14,229
France	43,468	49,839	50,619	51,837	53,158
Italy	19,624	22,157	23,793	25,232	25,909
NL	10,892	14,808	16,081	16,554	17,524
Sweden	11,869	14,662	16,142	15,631	16,077
UK	30,732	43,573	39,704	41,903	44,364
Russia	12,998	13,436	15,456	13,887	15,661
USA	309,340	446,231	485,955	492,424	
China	78,724	203,201	230,778	252,019	:
Japan	135,035	129,819	138,207	137,415	:
S Korea	28,629	52,492	61,711	65,992	:

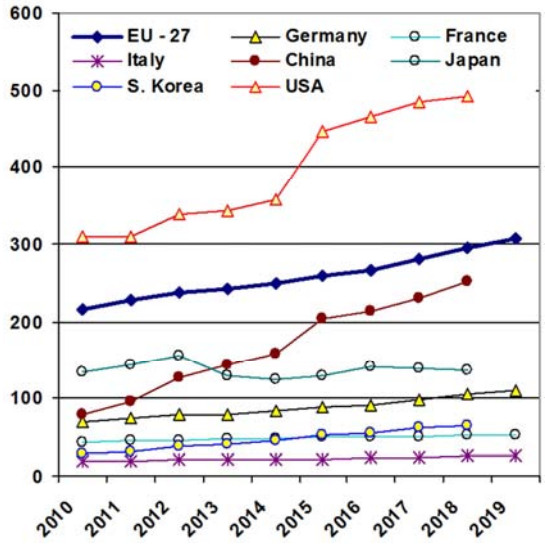

Figure 7. R&D expenditure of superpower countries of the EU, bn EUR [55].

R&D expenditure was less than EUR 500 million: Lithuania 484, Estonia 453, Latvia 195 and Iceland 445 million. This was a thousand times (!) less than US R&D expenditure.

German R&D expenditures in 2019 accounted for 35.7% of total EU-27 R&D expenditure and with France more than half (53.0%). If still the UK belonged to the EU, then its share in the EU-28 was only 12.6%. These three countries are also leaders in European science. However, the leader of the world rankings is definitely the USA, is larger than the three largest countries in Asia (455,426) combined.

Formation of high scientific results will be achieved as a rule also requires large expenditures by small countries are scarce or to achieve a multi-state collaboration.

Smaller countries also have smaller R&D of GDP expenditures and it is useful to analyse them in ratios.

Table 15. Research and development expenditure, % of GDP of EU-28, all sectors [56].

2007	2009	2010	2013	2015	2016	2017	2018	2019
1.77	1.93	1.92	2.01	2.03	2.04	2.07	2.11	2.13

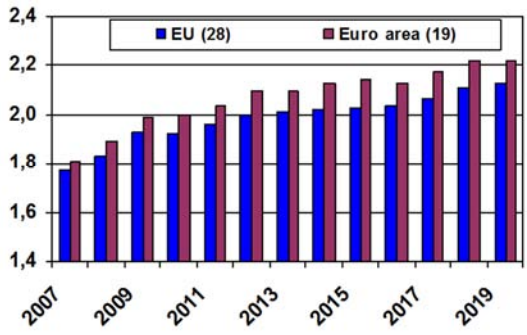

Figure 8. Research and development expenditure, % of GDP, all sectors [56].

In 2007 of Euro area (19) was *research and development expenditure* 1.81%/GDP and 2018 2.22%/GDP. Its level has been up to 0.11% higher than the EU-28 level. The same ratio applies to their entire economy.

However, the differences between national levels, as well as the overall economic level, are very different.

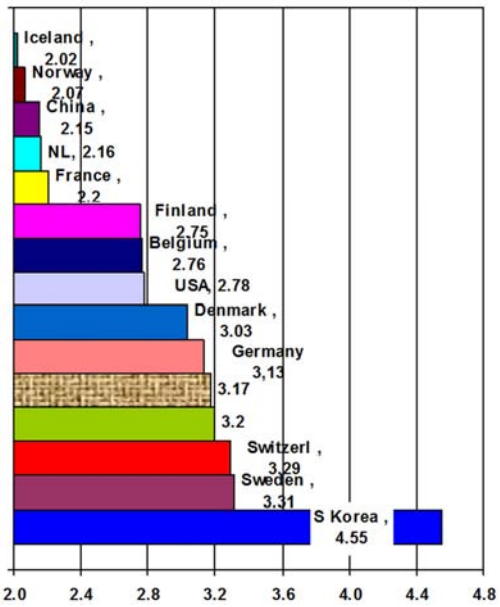

Figure 9. Research and development expenditure, % of GDP, all sectors [56].

Sweden topped the EU with 3.31% of GDP, down from 3.37% a year ago. The world's highest level in 2017 was South Korea's 4.55% / GDP. It was also very high in Switzerland - 3.29%, Japan - 3.2 and USA - 2.78%. Noteworthy was China's 2.15%, what was higher than the EU-28 average. Russia (1.1%) was almost half smaller than China. In total, 15 of the countries analysed were over 2% of GDP.

Decline in this level was in Ireland, Spain, Lithuania, Luxembourg, Slovenia, Finland, Sweden, Iceland and Japan. Less than 1% of GDP of EU countries were Bulgaria, Croatia, Latvia, Lithuania, Malta, Romania and Slovakia.

Table 16. R&D expenditure. Euro per inhabitant *[56]*

	2015	2016	2017	2018	2019
EU - 28	596.2	600	628.6	657.7	683
EA-19	667.4	682.1	719.5	751.3	775.9
Switzerland	2,507.6	:	2,355.9	:	:
Denmark	1,473.7	1,534.2	1,551.4	1,580.9	1,592.4
Sweden	1,504.3	1,537	1,615	1,544.6	1,571.6
Norway	1,302.2	1,308.5	1,410.5	1,431.9	1,501.3
Austria	1,223	1,281	1,286.9	1,372.7	1,432.3
Germany	1,093.4	1,121.7	1,206.4	1,264.2	1,316.8
Iceland	1,047	1,193.1	1,350.1	1,276.8	:
Luxembourg	1,204.4	1,235.8	1,220.1	1,170.3	1,233.1
Finland	1,109.5	1,080	1,121.7	1,167.7	1,217
Belgium	900.4	959.5	1,045.5	1,079.8	1,201.2
NL	876.2	897.3	941.4	963.5	1,014

The EU's lowest R&D expenditure in 2019 was: Romania 55; Bulgaria 73.2 and Latvia 101.6 euros per inhabitant. Of the major European countries, France was 793.3 above the EU average and just below the UK average of 665.7 euros.

For comparison, in 2018, R&D expenditure in the US was 1,503.9; South Korea 1,278.7 and Japan 1,086.8 euros per inhabitant. China was 166 and Russia 115.8 euros. Since 2010, these costs have increased 2.8 times in China; 1.5 times in the US and in Germany.

By sectors of EU-28 in 2018 were *business enterprise sector* – 1.41%; *government sector* – 0.23%; *higher education sector* – 0.46% and *private non-profit sector* 0.02% / GDP. R&D expenditures have been made in the *business enterprise* sector with a larger and also more direct economic effect.

Business enterprises R&D expenditures

Business enterprise sector R&D expenditures in 2019 made the EU-27 203.3 bn. The world leader is the USA - with 357.4 bn euros for China (195.1) and Japan (109.1); in Europe ahead of Germany (75.6) for France (34.9) and the UK (30.2 bn). Less than 200 million euros, or almost a thousand times smaller than the EU average business enterprise R&D expenditures however, there are some small EU countries such as Estonia, Latvia, Lithuania, Cyprus and Malta.

Business enterprise sector R&D expenditures were 66.3% in EU-27; USA 72.6%; China 77.4%; Japan 79.4%; Germany 69.1%; South Korea 80.5%; France 65.7% from total. Of the small but successful Baltic countries in 2019: Estonia 53.3%; Latvia 26.2% and Lithuania 43.0%. In 2017-2019, however, Estonia's business enterprise sector R&D expenditures have increased from 143.62 million to 241.5 million euros or 2/3 (68.1%). In 2016-2019, however, the growth of Latvia was 24.2 million or almost twice (89.6%) and Lithuania 93.5 million or almost twice (93.5%). For many, it grew by a third, for example in Slovakia it was 103.1 million or 31.9%.

At the same time, does the economic potential of a smaller country allow for higher spending? Let's look at it on a *% / GDP* basis.

If the EU-27 all sectors business enterprise sector / GDP were 2.19%; USA 2.82%; China 2,142%; Japan 3.28%; Germany 2.96% and South Korea 4.52%, then Estonia 1.61%; Latvia 0.64% and Lithuania 0.97%. The business enterprise sector% / GDP R&D expenditures of these countries were 1.46%, respectively; 2.05%; 1.66%; 2.6%; 2.19% and 3.63%. These figures for the Baltic countries were significantly lower: 0.86%; 0.17% and 0.43%. Consequently, they had, at least in theory, potential compared to large countries.

At the same time, however, it must be taken into account that

certain things must be spent for the normal functioning of the state - *Government sector*. They are almost the same in absolute terms, but very different in relative terms. For example, diplomatic representation, national defence…!

Table 17. Total researchers by sectors of performance - head count, EU-28 [57].

2007	2009	2010	2011	2013	2015	2017
2,170,019	2,331,024	2,429,084 ()	2,529,953	2,713,637	2,864,885	3,095,121

The number of researchers has increased by nearly one million (43%) in 10 years.

Table 18. Total researchers by sectors of performance - head count, by countries [57].

	2007	2011	2013	2015	2017
Germany	437,780	522,010	549,283	586,030	623,125
UK	377,210	429,009	466,689	496,953	:
France	278,480	338,470	366,299	:	416,217
Spain	206,190	220,254	208,767	214,227	225,995
Italy	141,878	151,597	163,925	174,327	195,560
Poland	97,289	100,723	109,611	118,494	187,905
NL	60,106	84,072	110,536	112,946	115,185
Sweden	71,244	80,154	101,820	108,761	107,042
Portugal	51,443	82,354	78,290	81,005	89,659
Austria	53,590	65,609	71,448	78,051	83,648
Belgium	51,278	63,207	66,724	73,709	78,867
Switzerland		:	:	70,834	73,502
Czechia	42,538	45,902	51,455	56,605	59,789
Denmark	42,992	56,845	57,654	60,492	61,961
Greece	:	45,239	53,744	60,736	61,616

Economic data in high-tech sectors

Next, we analyse economic data in high-tech sectors by NACE Rev.2 activity of EEA (EU).

Table 19. Number enterprises in high-technology manufacturing, top 18 [59].

	2008	2009	2010	2012	2013	2014	2015	2016
Czechia	:	3,881	3,608	3,507	3,465	3,402	3,393	3,425
Denmark	1,179	663	651	684	671	665	670	703
Germany	19,870	8,940	9,113	8,418	8,919	8,987	7,894	7,716
Spain	3,312	3,128	3,113	2,891	2,781	2,750	2,820	2,800
France	12,424	4,448	3,596	3,416	3,534	3,382	3,578	3,632
Italy	23,910	7,073	6,850	6,148	5,856	5,637	5,553	5,530
NL	2,810	1,479	1,661	1,716	1,882	1,885	1,881	1,862
Austria	1,608	662	667	693	688	707	681	695
Poland	8,354	2,987	3,148	3,093	3,501	3,543	3,238	3,512
Portugal	597	556	529	512	513	486	490	493
Romania	1,979	1,205	1,113	1,002	999	1,008	1,018	980
Finland	1,140	601	603	607	604	607	610	610
Sweden	3,191	3,131	3,083	1,855	1,804	1,822	1,835	1,865
UK	9,667	7,876	7,323	6,947	7,162	7,213	7,423	7,528
Norway	343	348	326	337	327	315	314	323
Switzerland		1,780	1,733	1,646	1,674	1,680	1,616	1,582

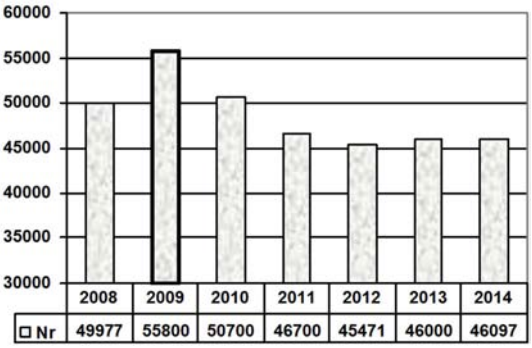

Figure 10. Number enterprises in high-tech sectors, EU28 [59].

Trend: Number businesses in high tech sectors are declining. While in 2009 their number increased to 55,800, it declined to over 10,000 in three years. It was hoped that the economic difficulties would be helped by mass start-ups. But it didn't help; only a framework was created to develop technical progress, but the content, the knowhow, was lacking. Developing technical creativity is a complex process. Only creating conditions, delivering the results expected by command?! Talents, talented people are also needed…

But on the other hand, a state or a company in financial difficulties will no longer have the means to sustain them.

So, Italy reduced the number of enterprises 3.4x, France them 2.8x, Austria 2.4x, Germany 2.2x… The number of individual countries like Norway remained stable. However, in 2008 - 2016 Slovakia increased the number of high-tech enterprises 3.6 times!

Table 20. Turnover of enterprises in high-technology manufacturing, million euro, top 18 [59].

	2008	2009	2010	2012	2013	2014
EU - 28	546,795	486,042	521,191	507,879	504,136	524,520
Czechia	12,511	10,426	12,116	13,218	11,644	12,065
Denmark	9,934	9,863	11,614	13,918	13,927	16,018
Germany	128,409	99,861	108,936	113,476	118,229	121,114
Estonia	468	426	956	1,791	1,848	1,871
Ireland	49,472	54,690	47,100	43,904	39,628	:
Greece	1,840	1,813	:*(c)*	1,443	2,088	1,543
Spain	24,202	21,070	20,946	17,617	17,640	17,193
France	76,202	68,687	71,151	69,999	73,389	68,467
Italy	50,120	45,682	48,957	47,224	46,510	44,247
Lithuania	304	251	324	289	329	390
Hungary	19,961	16,539	20,890	16,338	13,977	13,674
NL		19,110	22,135	21,251	18,420	38,930
Austria	8,477	7,916	8,397	8,304	9,027	9,431
Poland	11,528	10,475	15,123	12,374	11,629	12,857
Portugal	3,642	3,114	2,885	2,921	2,857	2,740
Romania	2,343	2,594	3,567	2,349	2,360	2,596
Slovenia	2,076	1,922	2,040	2,287	2,409	2,450
Slovakia	6,297		7,124	6,403	6,025	6,216
UK	46,204	39,721	45,923	42,395	40,143	40,922
Switzerland		69,400	81,820	103,658	104,274	105,129

Turnover decreased in 2009, but began to increase steadily in the following years. The great powers, however, did not reach the level of 2008 in 2014, but many small states surpassed it. Estonia's growth was 4.0x, NL 2.0x, Denmark 1.6x, Switzerland 1.5x, Lithuania 1.3x etc.

Table 21. Production value of enterprises in H-T manufacturing, in million euro, top 18 [59].

	2008	2009	2010	2012	2013	2014
EU – 28	485,479	430,000	:	448,566	450,523	470,349
Czechia	12,223	10,051	11,650	12,537	11,284	11,695
Denmark	10,288	10,082	11,344	13,734	13,789	15,787
Germany	113,566	89,678	98,505	103,695	108,348	110,528
Estonia	440	408	935	1,770	1,794	1,836
Ireland	46,911	52,015	46,541	43,218	38,903	:
Greece	1,689	1,663		1,316	1,849	1,378
Spain	21,235	18,145	18,405	16,365	16,252	16,234
France	61,281	55,474	58,242	56,420	59,430	60,668
Italy	49,100	43,010	47,862	44,856	45,188	42,884
Lithuania	273	227	310	284	305	358
Hungary	18,418	14,964	18,024	14,552	12,495	12,036
NL		12,808	14,779	15,308	13,436	33,772
Austria	7,570	7,224	7,356	7,805	8,432	8,818
Poland	10,613	9,387	13,166	11,092	10,889	11,700
Portugal	3,316	2,728	2,604	2,501	2,362	2,338
Romania	2,058	2,451	3,399	2,263	2,176	2,388
Slovenia	1,954	1,760	1,910	2,168	2,269	2,331
Slovakia	6,029		6,940	6,188	5,734	5,971
UK	43,274	36,319	42,866	39,540	37,797	37,599
Switzerland	:	72,640	85,459	108,484	108,729	110,403

Production was basically the same trend or even slightly better: Estonia's growth was 4.2x, NL 2.6x, Denmark 1.5x, Switzerland 1.5x, Lithuania 1.3x etc.

Table 22. Value added of enterprises in high-technology manufacturing, in million euro [59].

	2008	2009	2010	2012	2013	2014
EU - 28	159,914		163,551	157,619	154,805	:
Czechia	1,436	1,024	1,215	1,701	1,860	1,735
Denmark	4,354	4,326	5,108	6,323	6,494	7,580
Germany	40,600	33,429	38,432	38,852	39,876	42,906

	2008	2009	2010	2012	2013	2014
Estonia	113	91	121	155	160	170
Ireland	14,079	15,917	15,774	15,798	:	:
Greece	724	781		574	752	552
Spain	6,684	5,780	5,954	5,418	5,534	6,230
France	20,344	17,708	19,199	20,156	19,289	19,614
Italy	14,029	13,319	15,740	14,522	14,436	13,962
Lithuania	85	76	92	95	107	138
Hungary	2,717	2,395	2,628	2,989	2,770	2,784
NL	:	4,545	5,495	6,639	4,725	5,023
Austria	3,052	3,023	3,281	3,437	3,686	3,902
Poland	2,889	2,321	2,759	2,229	2,672	2,387
Portugal	859	710	697	684	719	711
Romania	618	593	706	680	696	748
Slovenia	890	758	822	865	899	981
Slovakia	648		958	830	637	687
Finland			3,902	1,325		2,735
Sweden				8,941	9,420	
UK	21,270	16,736	21,127	18,234	16,836	16,608
Switzerland		22,547	26,998	35,496	34,662	35,102

Value added was also basically the same trend or even slightly better: Denmark growth was 1.7x, Lithuania 1.6x, Switzerland 1.6x, Estonia 1.5x, Austria 1.3x, NL only 1.1x etc. However, many have not yet reached the level of 2008.

Table 23. Gross operating surplus of enterprises in high-technology manufacturing, in million euro [59].

	2008	2009	2010	2012	2013	2014
EU - 28	70,496		80,621	72,164	66,935	:
Czechia	519	227	472	779	1,010	918
Denmark	1,941	1,730	2,417	3,418	3,465	4,233
Germany	13,618	10,113	14,274	12,930	12,708	14,734
Estonia	38	23	48	67	64	66
Ireland	11,881	13,574	13,667	13,863	:	:
Greece	388	440		292	504	375
Spain	2,912	2,247	2,259	2,194	2,328	3,110
France	5,238	3,729	4,974	5,436	4,036	3,684
Italy	4,524	4,444	6,751	5,389	5,432	5,440
Lithuania	28	32	43	43	52	78
Hungary	1,405	1,300	1,401	1,717	1,604	1,638
NL		1,985	2,725	4,010	2,081	2,226
Austria	1,142	1,078	1,509	1,413	1,509	1,600
Poland	1,589	1,281	1,541	1,106	1,602	1,219
Portugal	413	276	271	287	328	303
Romania	318	335	417	358	331	340
Slovenia	474	323	403	423	440	496
Slovakia	382		684	574	384	427
Finland			1,351			569
Sweden				4,285	4,778	
UK	11,936	9,076	13,724	10,664	8,707	7,912
Switzerland	:	11,866	15,103	20,893	20,103	19,901

While EU28 exceeded its 2008 level of over 10bn in 2010, it has fallen to just € 67bn.

Gross operating surplus had grown in Lithuania 2.8x, Denmark 2.2x and Estonia 1.7x. Germany's growth was over one and Ireland two billion euro.

As a rule, everyone had increments but fluctuations. Big setback was the UK (4 bn); France (1.5 bn) and Finland (0.8 bn); lower Poland (0.4 bn).

Financial indicators summary: it was great instability!

Table 24. Key indicators of high-technology manufacturing [59].

	2008	2012	2013	2014
Turnover	546,795	507,879	504,136	524,520
Production value	485,479	448,566	450,523	470,349
Value added	159,914	157,619	154,805	
Gross operating surplus	70,496	72,164	66,935	

Turnover and production values, although falling in 2009, increased in the following years: in 2014 they were 4.1% and 3.1% below their 2008 levels, respectively. The value of the year 2008 was exceeded already in 2010, but subsequently decreased.

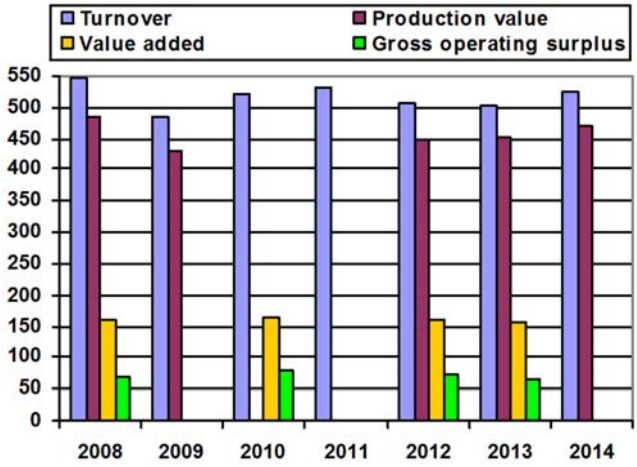

Figure 11. Key indicators of high-technology sectors in bn euro, EU28 [59].

Table 25. Turnover of high-technology manufacturing and knowledge-intensive high-technology sectors, million euros [59].

	2008	2009	2010	2012	2013	2014
Germany	318,562	284,182	294,840	315,637	328,955	342,208
France	:*(c)*	218,677	228,315	232,140	228,338	225,432
UK	265,337	227,928	255,481	273,479	267,555	289,325

Table 26. Production value of high-technology manufacturing and knowledge-intensive high-technology sectors, million euro [59].

	2008	2009	2010	2012	2013	2014
Germany	263,287	239,675	243,659	266,652	280,619	290,862
France	:	204,573	214,399	219,608	215,308	221,656
Italy	153,671	145,917	155,229	150,591	146,718	142,116
UK	249,559	214,110	237,881	255,898	251,887	275,255

Table 27. Value added of high-technology manufacturing and knowledge-intensive high-technology sectors, million euro [59].

	2008	2009	2010	2012	2013	2014
Germany	130,401	121,850	123,565	135,478	143,078	152,448
France	:	83,890	87,763	89,861	88,214	89,026
UK	123,567	105,952	111,830	125,100	121,586	136,941

This was in 2014 turnover in high-tech manufacturing and knowledge-intensive high-tech services sectors of Germany 342,208; UK 289,325 and France 225,432 million euro. Production value was respectively 290,862; 275,255 and 221,656 million euro. Value added were respectively 152,448; 136,941 and 89,026 million euro.

Table 28. Gross operating surplus of high-technology manufacturing and knowledge-intensive high-technology sectors, million euro [59].

	2008	2009	2010	2012	2013	2014
Belgium		8,188		10,277	11,401	11,562
Denmark	4,950	5,017	5,377	6,436	6,551	7,770
Germany	56,441	51,000	54,158	57,386	59,081	61,937
Spain	21,925	20,233	19,278	16,613	16,181	15,745
France		30,141	31,864	30,181	27,230	24,806
Italy	32,063	29,504	33,900	31,390	28,618	28,021
NL		11,956	13,763	14,587	12,510	12,730
Poland		7,167	8,594	8,414	8,076	7,951
UK	57,036	50,885	53,255	60,460	56,870	63,834

In 2012 was total EU-28 Gross operating surplus 293,328 and in Sweden 8,172 million euro.

Table 29. Total purchases of goods and services of high-technology manufacturing and knowledge-intensive high-technology sectors, million euros [60].

	2008	2009	2010	2012	2013	2014
Germany	203,235	178,555	183,054	191,877	196,811	202,070
France		130,443	138,531	141,142	138,082	137,262
Italy	96,902	89,646	94,553	93,353	90,734	87,569
NL		41,327	44,075	42,233	40,867	64,899
UK	142,781	122,608	142,636	147,447	145,748	154,860

This was in 2014 total purchases of goods and services in H-T manufacturing and knowledge-intensive H-T services sectors of Germany 202,070; UK 154,860 and France 137,262 million euro.

In H-T manufacturing it was respectively Germany 78,222; UK 24,253 and France 48,632 million euro. EU-28 total was 367,321 million euro. Production value was respectively 290,862; 275,255 and 221,656 million euro. Value added were respectively 152,448; 136,941 and 89,026 million euro.

Table 30. Total purchases of enterprises in high-technology manufacturing, mln euro [60].

	2008	2009	2010	2012	2013	2014
Germany	88,076	64,838	70,954	74,117	77,690	78,222
France	53,772	48,037	50,421	48,428	51,924	48,632
UK	25,124	22,867	24,126	24,246	22,973	24,253

High-tech products foreign trade

Table 31. Intra-EU28. Total high-tech products, million euro [58].

	2007	2009	2010	2012	2016	2017
Export	292,810	266,680	306,910	334,839	385,308	413,652
Import	284,111	251,340	293,588	314,775	366,299	397,028
Balance	+8,699			+20,064	+19,009	+16,624

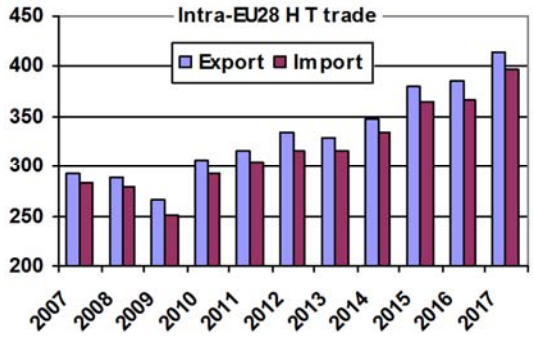

Figure 12. Intra-EU28 trade of EU28 [58].

The Intra-EU28 trade was consistently positive, indicating that high-tech products from EU Member States are required by neighbours, either because of better quality or, moreover, because of the lack of assortment there. We add that these groups of goods are duty free. It characterizes the beneficial cooperation of EU Member States, exporters of good with buyers.

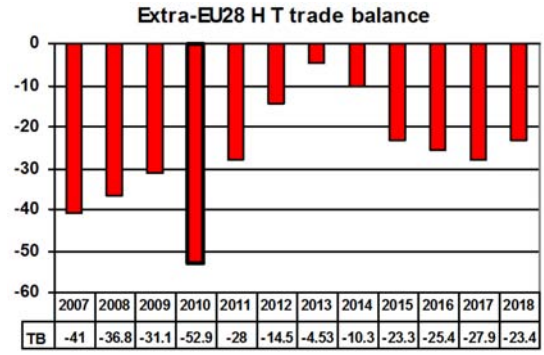

Figure 13. Extra-EU28 high-tech products trade balance, bn euro [58].

Table 32. Extra-EU28. Exports. SITC06: Total high-tech products, million euro [58].

	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017	2018
Exports	199,215	201,914	187,262	218,518	264,935	266,427	266,429	304,648	310,629	334,702	349,111
Imports	240,201	238,693	218,392	271,414	279,407	270,954	276,721	327,915	336,001	362,620	372,552
TB	-40,986	-36,779	-31,130	-52,896	-14,472	-4,527	-10,292	-23,267	-25,372	-27,918	-23,441

The biggest negative high-tech trade balances of the extra-EU28 were related to the global economic crisis, which means until 2010. The economic difficulties of non-EU countries began to manifest many years before the big crisis of 2009. The crisis did not come unexpectedly and was caused by many factors. After the crisis, in 2010, many companies were suffering financial difficulties. They only bought what was urgent and how the wallet allowed it. This is also the source of the EU28 foreign economic performance during this period.

Here is the trend reversed: EC28 countries outside the EU as a whole will buy high-tech products more than they sell there. Consequently, a closed trade, intra-EU here, not be fully functional and not useful to consumers.

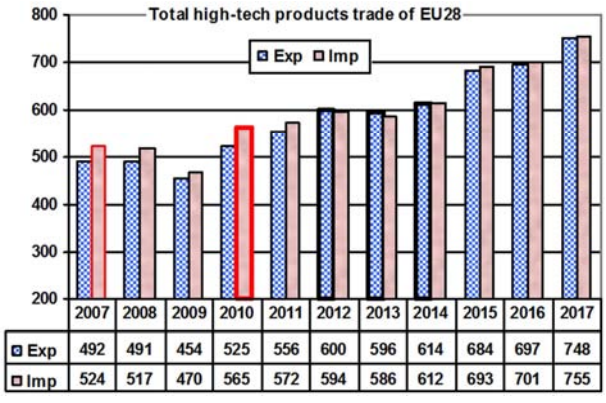

Figure 14. Total EU28 trade with high-tech products, bn EUR [58].

As a rule, the total balance of high-tech products for the EU28 was negative, which means an outflow of money for the EU as a whole. Only in 2012 it was +6 bn, in 2013 +10 bn and in 2014 + 2 bn euro. The largest total negative balance was in 2010 -40 bn and also in 2007 -32 bn euro.

However, for better clarity, we need to analyse countries and commodity groups and their dynamics in more detail. [32 - 33]

Table 33. High-tech exports, % of exports.

	2015	2016	2017	2018
EU (28)	17.0	17.8	17.8	17.9
Ireland	24.4	28.7	34.5	34.7
Malta	24.1	18.5	25.5	25.6
Netherlands	20.4	21	21.6	21.3
France	21.7	21.7	20.6	20.5
Czechia	15.5	15	16.1	17.8
UK	16.7	18.4	18.1	16.7
Hungary	15.4	15.9	16.0	15.6
Germany	14.9	15.2	15.1	15.1

In 2018, Intra-EU28 exports had the largest volume of Electronics-telecommunications (ET) - 144.1 bn, Computers-office machines (COM) - 73.1 bn and Pharmacy (P) - 70.4 bn euros. Aerospace (AS) was much smaller at 41.2 bn euros. Over half were Germany and Netherlands products. France accounted for only 40% of German exports.

Table 34. Intra-EU28. Exports. Million EUR. 2018.

	Total	AS	COM	ET	P
EU - 28	413,652	41,236	73,107	144,066	70,433
Belgium	24,563	337	1,624	3,618	12,355
Bulgaria	1,050	3	123	568	90
Czechia	24,779	207	10,388	11,155	479
Denmark	4,396	78	772	1,293	874
Germany	103,937	14,336	15,373	30,514	17,623
Estonia	872	1	21	689	13
Ireland	18,398	702	2,439	1,634	11,882
Greece	1,170	2	630	214	157
Spain	9,255	2,401	702	1,434	1,743
France	41,063	13,905	1,984	10,007	6,568
Croatia	792	22	25	189	371
Italy	18,307	1,091	1,413	3,960	7,157
Latvia	766	6	119	514	40
Lithuania	1,343	11	129	436	72
Luxembourg	848	3	58	562	22
Hungary	12,978	79	2,463	6,176	1,548
NL	97,768	1,147	26,871	48,849	7,909
Austria	13,615	209	1,260	6,793	2,892
Poland	13,356	599	4,622	4,639	922
Portugal	1,438	4	59	776	137
Romania	4,653	19	178	3,109	109
Slovenia	1,349	11	89	403	319
Slovakia	6,694	10	918	5,135	72
Finland	1,555	11	152	580	39
Sweden	7,938	87	1,160	2,965	1,734
UK	23,764	4,161	3,189	5,772	3,969
Norway	24,779	416	170	195	49
Switzerland	1,619	375	416	282	16,417

In 2018, Extra-EU28 Exports had the largest volume of Aerospace - 93.9 bn, Pharmacy - 78.0 bn and Electronics-telecommunications - 67.9 bn euros. The largest export volumes of Extra-EU28 were from Germany, France and UK.

Table 35. Extra-EU28. Exports, high-tech products, million euro.

	Total	AS	COM	ET	P
EU - 28	349,111	93,861	20,129	67,882	78,039
Belgium	16,027	1,068	242	999	9,962
Bulgaria	616	10	47	315	117
Czechia	5,778	397	2,001	1,888	72
Denmark	4,310	75	617	758	1,555
Germany	95,911	22,007	3,423	22,886	13,999
Estonia	793	22	18	601	7
Ireland	30,092	4,219	1,584	4,384	16,559
Greece	334	11	68	87	47
Spain	6,895	1,481	264	1,203	1,855
France	59,713	37,547	1,367	6,878	7,184
Croatia	393	2	22	64	76
Italy	17,600	1,905	698	3,300	5,921
Latvia	722	307	22	259	17
Lithuania	900	26	137	195	144
Hungary	3,630	12	856	1,593	327
NL	32,832	2,634	5,013	8,690	6,942
Austria	7,914	385	186	2,331	2,979
Poland	5,165	2,041	540	850	111
Portugal	872	81	43	453	133
Romania	1,006	50	45	458	50
Slovenia	819	76	38	93	404
Slovakia	980	18	123	649	14
Finland	2,348	72	137	901	76
Sweden	7,888	404	808	2,707	1,665
UK	44,905	18,910	1,810	4,898	7,797
Norway	1,825	224	*98*	70	219
Switzerland	1,825	1,114	*158*	240	13,507

The largest volume of goods of Intra-EU28 imports in 2018 was Electronics-telecommunications - 134.7 bn EUR, which made up 33.9% of high-tech products. Of this 23.8% was imported by Germany. Over 10 bn were imported by France, Netherlands and UK.

Table 36. Intra-EU28. Imports. high-tech products, million euro.

	Total	AS	COM	ET	P
EU - 28	397,028	42,052	68,051	134,710	72,110
Belgium	25,796	386	3,352	4,391	13,352
Bulgaria	1,968	8	267	887	339
Czechia	16,460	51	4,323	7,918	1,139
Denmark	7,398	109	2,040	2,714	953
Germany	86,290	7,302	14,682	32,022	16,980
Estonia	1,321	28	157	803	61
Ireland	15,737	9,393	2,204	1,481	1,851
Greece	2,985	30	400	751	1,138
Spain	19,913	1,398	3,925	5,565	3,721
France	46,358	5,040	8,341	12,452	10,052
Croatia	1,561	23	221	604	304
Italy	27,915	294	3,845	8,011	8,569
Latvia	1,111	13	233	445	101
Lithuania	1,967	12	359	771	244
Luxembourg	1,099	8	272	429	47
Hungary	10,174	73	1,201	5,336	1,315
NL	27,714	706	6,159	10,852	2,758
Austria	11,926	57	1,944	4,973	1,998
Poland	16,916	429	3,104	7,077	2,251
Portugal	5,231	677	810	1,827	627
Romania	7,068	19	651	3,577	693
Slovenia	1,706	3	213	655	331
Slovakia	9,383	45	1,203	6,524	394

	Total	AS	COM	ET	P
Finland	5,850	232	1,538	2,200	577
Sweden	13,064	117	3,451	5,829	1,145
UK	38,888	4,656	7,446	10,825	8,576
Norway	2,678	321	430	264	353
Switzerland	14,527	757	1,471	761	7,926

In 2018 was the largest volume of goods Electronics-telecommunications - EUR 140.2bn, representing 37.6% of Extra-EU28 imports. Of this the Netherlands imported 31.1% and Germany 20.4%, thus more than half. UK's share was 14.2% and France's 6.5%. These four imported a total of nearly three quarters.

Aerospace imported 62.8 bn and Computers-office machines 67.5 bn euros. Outside the EU, Aerospace bought more UK (25.5%) and Computers Netherlands (38.7%).

Table 37. Extra-EU28. Imports, high-tech products, million euro.

	Total	AS	COM	ET	P
EU - 28	372,552	62,677	67,526	140,166	41,225
Belgium	13,834	1,181	391	1,342	7,121
Bulgaria	702	58	63	261	70
Czechia	15,004	785	4,877	7,597	139
Denmark	2,108	325	292	735	182
Germany	78,043	9,509	14,269	28,576	7,942
Estonia	475	20	26	327	14
Ireland	17,448	11,317	2,184	1,102	2,299
Greece	1,264	25	641	333	89
Spain	9,518	1,652	722	3,993	1,515
France	31,026	11,726	2,173	9,038	2,766
Croatia	505	10	53	99	210
Italy	16,493	939	1,738	5,218	5,168
Latvia	1,349	845	40	397	26
Lithuania	309	31	38	120	14
Luxembourg	774	273	21	387	4
Hungary	6,555	43	1,705	2,995	892
NL	87,562	2,969	26,117	43,529	5,872
Austria	10,720	413	775	4,883	3,595
Poland	9,529	1,689	2,093	2,999	247
Portugal	1,520	271	50	746	92
Romania	2,210	152	210	1,049	95
Slovenia	869	114	70	208	260
Slovakia	1,984	36	77	1,148	64
Finland	1,508	74	213	720	90
Sweden	5,596	805	650	2,350	476
UK	55,199	17,259	8,013	19,847	1,943

Table 38. Exports total high-tech products of Europe in all countries of the world, in million euro, top15.

	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017	2018
EU – 28	492,025	491,317	453,942	525,428	599,779	596,129	614,133	683,870	697,431	748,282	:
Germany	125,210	122,304	112,641	133,195	155,222	155,251	160,429	177,911	183,294	193,535	199,848
NL	73,455	70,089	65,621	80,538	95,779	89,559	94,330	104,685	108,346	124,737	130,600
France	68,061	73,621	68,681	80,611	88,614	89,299	91,050	99,029	98,235	97,463	100,776
UK	54,179	49,585	48,511	55,481	64,106	62,941	59,377	69,379	68,123	70,850	68,669
Ireland	22,820	20,756	18,351	17,246	20,056	18,368	19,039	27,197	33,935	41,993	48,491
Switzerland	24,704	26,421	26,319	32,793	37,012	38,286	40,144	46,359			
Belgium	20,839	21,801	23,362	25,840	29,724	30,740	34,153	36,455	36,002	37,274	40,590
Italy	21,890	21,936	19,849	22,091	24,800	25,929	26,759	28,687	29,731	33,958	35,907
Czechia	12,628	14,115	12,331	16,123	19,665	18,431	20,168	22,132	22,117	25,898	30,556
Austria	13,266	13,358	11,509	13,620	16,594	18,786	19,270	19,512	19,071	21,984	21,529
Poland	3,108	4,950	5,585	7,289	8,594	10,274	13,122	15,183	15,658	17,453	18,521
Hungary	14,857	14,928	13,235	15,668	13,959	13,205	12,088	13,654	14,681	16,106	16,609
Spain	7,832	7,966	7,793	9,119	11,447	13,025	12,606	13,892	15,321	16,245	16,150
Sweden	16,360	16,463	13,730	17,322	17,236	16,463	16,004	17,081	16,848	16,124	15,827
Denmark	8,786	8,515	8,315	6,762	7,788	7,765	8,244	9,218	9,099	8,737	8,705

Exports means an influx of money into a country. As a whole, EU-28 high tech product exports grew by over a quarter trillion (+256.257 million euros) in 2007-2017, or 1.52 times.

It has grown strongly in Poland (6.0x), Romania (5.5x), Latvia (5.3x), Cyprus (2.7x), Estonia (2.6x), Lithuania (2.4x), Ireland (2.1x), Croatia (2.0 x), Belgium (1.9x), Switzerland (1.9x), Lithuania (1.8x) and Germany (1.6x). Exports in Iceland (5.8x), Luxembourg (5.6x), Finland (2.9x) and Malta (1.6x) have fallen sharply. However, some countries have maintained long-term levels. All this shows the high-tech product high quality and the growing demand for them.

Table 39. Imports total high-tech products of Europe in all countries of the world, in million euro, top 10.

	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017	2018
EU - 28	524,313	517,428	469,732	565,001	594,055	586,119	612,039	692,695	701,467	755,505	:
Germany	108,277	107,370	99,212	124,248	126,314	125,554	134,111	148,514	150,744	159,570	164,333
NL	66,431	64,794	58,688	69,761	77,302	74,827	76,100	93,640	96,955	113,849	115,276
UK	74,147	67,104	62,138	78,007	82,316	82,702	85,280	98,585	98,863	97,720	94,087
France	61,864	61,633	60,382	68,703	74,527	73,370	74,900	79,676	79,264	79,630	77,384
Italy	32,412	31,427	29,154	40,492	34,647	32,859	33,448	37,972	37,962	41,514	44,408
Belgium	21,568	21,533	22,655	24,499	29,192	29,451	32,259	34,080	33,720	35,839	39,630
Ireland	15,363	13,236	11,729	12,742	16,274	14,807	17,919	21,057	26,280	33,330	33,186
Czechia	13,348	14,600	13,069	18,190	18,608	17,802	19,760	23,660	22,166	26,738	31,464

	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017	2018
Spain	26,820	28,491	19,914	22,559	20,396	20,218	21,675	25,387	26,357	29,172	29,431
Poland	11,234	14,041	12,617	15,611	16,277	16,913	19,047	22,355	22,474	24,963	26,445

Here again, between 2007 and 2017 the total grew by almost a quarter trillion (+231.192 million euros) or 1.44 times. This meant that the total high-tech products trade improved for EU28 over 25 bn euro. However, trade balance is to the detriment of the EU: 748,282 - 755,505 = -7,223 million euro or ca minus one percent.

Below we analyse high-tech trade by major products. Let's look at Intra-EU28, Extra-EU28 and All Countries in the World by Aerospace (AP), Computers-Office Machines (COM), Electronics-Telecommunications (ET) and Pharmacy (P).

Table 40. Intra-EU28. Exports SITC06. High-tech products, million euro.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total	266,680	306,910	316,032	334,839	329,700	347,706	379,219	385,308	413,652	:
AP	31,283	33,437	36,050	41,929	42,107	39,846	43,726	45,930	41,236	:
COM	57,555	61,370	59,185	60,810	58,568	63,316	66,710	65,800	73,107	:
ET	84,358	108,093	108,844	108,508	105,228	113,569	130,179	131,503	144,066	:
P	34,180	38,715	40,139	53,019	53,758	57,777	60,509	62,944	70,433	*70,433*

Table 41. Extra-EU28. Exports SITC06. High-tech products, million euro.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total	187,262	218,518	240,086	264,935	266,427	266,429	304,648	310,629	334,702	349,111
AP	42,859	51,489	54,192	65,471	70,577	69,266	84,373	87,551	90,233	93,861
COM	17,213	18,540	19,617	20,878	20,031	19,534	19,123	18,415	19,071	20,129
ET	44,265	53,389	58,067	56,579	53,998	53,906	59,531	62,475	67,462	67,882
P	27,802	31,071	37,335	43,447	44,816	47,857	59,483	59,438	69,130	78,039

Table 42. Intra-EU28. Imports SITC06. High-tech products, million euro.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total	284,111	278,735	251,340	293,588	303,707	314,775	315,165	335,317	364,758	366,299	397,028	:
AP	23,390	24,896	23,716	29,195	29,219	34,658	35,368	38,045	40,972	43,211	42,052	42,052
COM	73,565	66,590	55,330	59,247	57,410	57,930	55,367	59,070	62,385	61,060	68,051	68,051
ET	95,440	93,363	80,146	103,910	107,772	105,625	104,689	109,356	124,550	124,196	134,710	134,710
P	31,035	29,588	36,467	39,658	42,240	48,350	51,952	58,240	60,824	62,774	72,110	72,110

Table 43. Extra-EU28. Imports SITC06. High-tech products, million euro.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total	240,201	238,693	218,392	271,414	268,120	279,407	270,954	276,721	327,915	336,001	362,620	372,552
AP	32,927	33,293	35,882	39,831	34,289	42,810	42,371	42,238	48,608	60,561	61,121	62,677
COM	60,601	57,559	47,769	59,035	56,941	61,584	60,762	61,819	67,358	62,726	65,618	67,526
ET	85,967	87,048	74,785	103,727	100,883	95,666	91,103	92,374	118,220	117,530	133,327	140,166
P	16,085	16,218	18,845	21,353	24,253	26,951	26,339	27,851	34,734	37,077	42,469	41,225

Table 44. All countries of the world STK_FLOW: Exports SITC06. High-tech products, million euro.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	492,025	491,317	453,942	525,428	556,123	599,779	596,129	614,133	683,870	697,431	748,282
AP	67,141	72,645	74,142	84,926	90,242	107,400	112,683	109,113	128,101	133,483	131,279
COM	95,060	86,753	74,768	79,909	78,804	81,690	78,600	82,851	85,834	84,216	92,643
ET	158,985	154,784	128,623	161,482	166,912	165,089	159,226	167,473	189,711	194,064	211,303
P	50,146	52,016	61,982	69,787	77,477	96,466	98,575	105,634	119,992	123,741	139,608

Table 45. All countries of the world STK_FLOW: Imports SITC06. High-tech products, million euro.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	524,313	517,428	469,732	565,001	571,829	594,055	586,119	612,039	692,695	701,467	755,505
AP	67,141	72,645	74,142	84,926	90,242	107,400	112,683	109,113	128,101	133,483	131,279
COM	134,167	124,149	103,099	118,281	114,351	119,514	116,129	120,892	129,743	123,563	134,020
ET	181,407	180,411	154,931	207,636	208,655	201,291	195,792	201,730	242,769	241,114	267,225
P	47,119	45,806	55,312	61,011	66,494	75,301	78,291	86,091	95,558	99,919	112,528

Other than Pharmacy, other product groups have a negative balance. Pharmacy was +27,080; COM trade balance was -41,377 and ET was -55,922 million euro.

The largest importers of the Aerospace group were the UK with 17,259; France 11,726; Ireland - 11,317 and Germany - 9,509 million euro.

Table 46. Imports total high-tech products of Europe in all countries of the world, in million euros, top 10.

	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017	2018
EU - 28	524,313	517,428	469,732	565,001	594,055	586,119	612,039	692,695	701,467	755,505	:
Germany	108,277	107,370	99,212	124,248	126,314	125,554	134,111	148,514	150,744	159,570	164,333
NL	66,431	64,794	58,688	69,761	77,302	74,827	76,100	93,640	96,955	113,849	115,276
UK	74,147	67,104	62,138	78,007	82,316	82,702	85,280	98,585	98,863	97,720	94,087
France	61,864	61,633	60,382	68,703	74,527	73,370	74,900	79,676	79,264	79,630	77,384
Italy	32,412	31,427	29,154	40,492	34,647	32,859	33,448	37,972	37,962	41,514	44,408
Belgium	21,568	21,533	22,655	24,499	29,192	29,451	32,259	34,080	33,720	35,839	39,630
Ireland	15,363	13,236	11,729	12,742	16,274	14,807	17,919	21,057	26,280	33,330	33,186
Czechia	13,348	14,600	13,069	18,190	18,608	17,802	19,760	23,660	22,166	26,738	31,464
Spain	26,820	28,491	19,914	22,559	20,396	20,218	21,675	25,387	26,357	29,172	29,431
Poland	11,234	14,041	12,617	15,611	16,277	16,913	19,047	22,355	22,474	24,963	26,445

Table 47. Trade balance of EU-28, All countries of the world. high-tech products, million euro.

2018	Export	Import	Balance
Belgium	40,590	39,630	+
Bulgaria	1,666	2,670	
Czechia	30,556	31,464	
Denmark	8,705	9,506	
Germany	199,848	164,333	+
Estonia	1,664	1,796	
Ireland	48,491	33,186	+
Greece	1,504	4,249	+
Spain	16,150	29,431	
France	100,776	77,384	+
Croatia	1,185	2,066	
Italy	35,907	44,408	
Latvia	1,489	2,460	
Lithuania	2,243	2,276	
Luxembourg	983	1,873	
Hungary	16,609	16,729	-
Netherlands	130,600	115,276	+
Austria	21,529	22,645	
Poland	18,521	26,445	
Portugal	2,310	6,751	
Romania	5,658	9,278	
Slovenia	2,168	2,575	
Slovakia	7,674	11,367	
Finland	3,904	7,357	
Sweden	15,827	18,659	
UK	68,669	94,087	

All had increased imports by 2018, with the exception of Greece, Luxembourg, Malta, Finland and Iceland.

If Germany increased by 56 bn or 51.7%; then Netherlands near 49 bn or 73.5%; UK near 20 bn or 26.9%; France 15.5 bn or 25.1%…

As a whole grew, the EU - 28 high tech product imports in 2007 - 2017 1.44 times, slower than exports, but in general the trade balance was negative - 7.2 bn euros.

In figure 15 trendline shows steady growth after the 2009 crisis.

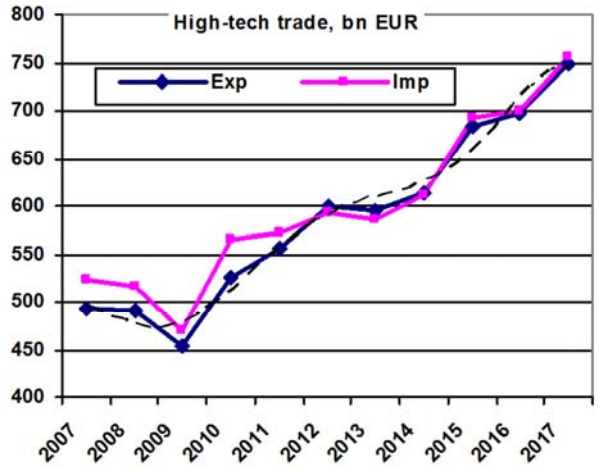

Figure 15. EU-28 trade of high-tech products with the world, bn euro.

Table 48. EU-28 trade of high-tech products with the world, million euros.

	2007	2009	2010	2013	2016	2017
Export	492,025	453,942	525,428	596,129	697,431	748,282
Import	524,313	469,732	565,001	586,119	701,467	755,505
Balance	-32,288	-15,790	-39,573	+10,010	-4,036	-7,223

4. Conclusions

Germany is largest European economy, also by *high technology production*, the EU economic motor, which depends on development of most economic indicators throughout of EU.

Countries economy has increased after the crisis. The economies of the countries have grown since the crisis. Economic growth was mainly achieved by increasing labour productivity.

In conclusion, both the UK and the EU economies are weakening in the increasingly competitive world with the USA, China, Japan, India and other countries. Already we can say that Brexit is economically bad for both.

The situation of global economy in recent years shows, what the superpowers states of EU have lost their leading position also to India, Russia, Brazil and Indonesia. At the same time, the UK was the second economic power in the EC. Think about, whether a fragmented Europe can stand alone against the new global economic powers?

The EU appears to be successful in this area, as evidenced by the high volumes of high technology production exports – ¾ trillion euro per year.

Just as the entire EU economy and foreign trade has been a major engine of Germany. However, medium-sized countries such as the Netherlands, the Nordic countries, the Czech Republic, Poland and the Baltic, among the EU newcomers, are also successful.

The Intra-EU28 trade was consistently positive, indicating that high-tech products from EU Member States are required by neighbours, either because of better quality or, moreover, because of the lack of assortment there. We add that these groups of goods are duty free. It characterizes the beneficial cooperation of EU Member States, exporters of goods with buyers.

Until 2012 the trade balance was firmly to the detriment of Europe. In 2010, the deficit was as high as 40 bn, then in 2012 - 2014 it was just in favour of the Europeans, but subsequently it was still negative. In 2015 was the deficit near 9 bn and in 2017 over 7 bn euro. This means the outflow of high-tech products from the EU-28. Without UK the EU trade balance would be positive.

Trend: number businesses in high tech sectors are declining. While in 2009 their number increased to 55,800, it declined to over 10,000 in three years. It was hoped that the economic difficulties would be helped by mass start-ups. But it didn't help; only a framework was created to develop technical progress, but the content, the knowhow, was lacking. Developing technical creativity is a complex process. Only creating conditions, delivering the results expected by command?! Talents, talented people are also needed…

But on the other hand, a state or a company in financial difficulties will no longer have the means to sustain them.

So, Italy reduced the number of enterprises 3.4x, France them 2.8x, Austria 2.4x, Germany 2.2x… The number of individual countries like Norway remained stable. However, in 2008 - 2016 Slovakia increased the number of high-tech enterprises 3.6 times!

The challenge for the EU is to achieve a positive trade balance as a whole, as well as for individual high technology production commodity groups.

Development of EU has been uneven and partially ineffective.

High technology makes it possible to quickly exit the COVID 19 caused by the economic crisis.

References

[1] High technology, Collins Dictionary http://www.collinsdictionary.com/dictionary/english/high-technology

[2] Low technology, Collins Dictionary http://www.collinsdictionary.com/dictionary/english/high-technology

[3] Albrecht, Jörn (1987). Johannes Gutenberg-Universität, Fachbereich Angewandte Sprachwissenschaft (Hrsg.), Translation und interkulturelle Kommunikation, S. 232

[4] Sommerlattem, Tom; Deschamps, Jean-Philippe (1986). Der strategische Einsatz von Technologien, in: Arthur D. Little International (Hrsg.), Management im Zeitalter der Strategischen Führung, S. 50 f.

[5] Manufacturing. Encyclopaedia Britannica http://www.britannica.com/EBchecked/topic/849534/manufacturing

[6] Tanning, Lembo & Tanning, Toivo (2015). The Economic Crisis Lessons of Europe. LAP. Lambert Academic Publishing. Saarbrücken, Germany, p 540.

[7] Tanning, Lembo & Tanning, Toivo (2009). Rahvusvaheline majandus, part I (International economy I), Tallinn University of Technology. Tallinn, 76-83

[8] Tanning, Lembo & Tanning, Toivo (2008). Uus Euroopa Liit-27 (New European Union-27). Tallinn University of Technology. Tallinn, p 417.

[9] Classifications. Eurostat. https://ec.europa.eu/eurostat/data/classifications

[10] NACE Rev. 2 - Statistical classification of economic activities https://ec.europa.eu/eurostat/web/nace-rev2/overview

[11] Structural business statistics introduced. Eurostat http://ec.europa.eu/eurostat/statistics-explained/index.php/Manufacturing_statistics_-_NACE_Rev._2

[12] Methodology. Annual accounts. National accounts (including GDP). Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/national_accounts/methodology

[13] Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E). Turnover or gross premiums written. Manufacturing. Code: sbs_na_ind_r2. Last update: 22-10-2018.

[14] World Factbook. Country comparison. CIA. 2020 https://www.cia.gov/library/publications/resources/the-world-factbook/

[15] World Bank data. Dec 2020 http://databank.worldbank.org/data/

[16] OECD. Stat http://stats.oecd.org/index.aspx

[17] Brezinski, C.; Zaglia, M. R. (1991). Extrapolation Methods. Theory and Practice by, North-Holland.

[18] Armstrong, J. Scott; Collopy, Fred; Yokum, J. Thomas (2004). "Decomposition by Causal Forces: A Procedure for Forecasting Complex Time Series" http://www.forecastingprinciples.com/paperpdf/Decomposition%20by%20Causal%20Forces.pdf

[19] Zhao, S; Yang, K.; Yang, X. (2011). "Reconstruction from truncated projections using mixed extrapolations of exponential and quadratic functions". J Xray Sci Technol. pp. 155–172 http://imrecons.com/wp-content/uploads/2013/02/extrapolation.pdf

[20] Freedman, David A. (2005) Statistical Models: Theory and Practice, Cambridge University Press.

[21] Bethea, R. M.; Duran, B. S.; Boullion, T. L. (1985). Statistical Methods for Engineers and Scientists. New York: Marcel Dekker. ISBN 0-8247-7227-X.

[22] Meade, N.; Islam, T. (1995). "Prediction Intervals for Growth Curve Forecasts". Journal of Forecasting. 14 (5): 413–430. doi: 10.1002/for.3980140502.

[23] Schittkowski, K. (2002). Data Fitting in Dynamical Systems. Boston: Kluwer. ISBN 1402010796.

[24] Seber, G. A. F.; Wild, C. J. (1989). Nonlinear Regression. New York: John Wiley and Sons. ISBN 0471617601.

[25] Wooldridge, Jeffrey (2012). Introductory Econometrics: A Modern Approach (Fifth ed.). Mason, OH: South-Western Cengage Learning. pp. 22–23. ISBN 978-1-111-53104-1.

[26] Dodge, Y. (2003) The Oxford Dictionary of Statistical Terms, ISBN 0-19-920613-9.

[27] Saari, Seppo. (2011). Production and Productivity as Sources of Well-being. MIDO OY. pp. 25. http://www.mido.fi/index_tiedostot/

[28] Kalle, Eero. (2013) Tootlikkusealane evolutsioon Eestis (The evolution of productivity in Estonia). Tallinn University of Technology, 244.

[29] Paas, Tiiu (1997). Kvantitatiivsed meetodid majanduses: majandusmatemaatika. (Quantitative Methods in Economics: Economic Mathematics). Tartu. Tartu University Press.

[30] Paas, Tiiu and Vahi, Triin. Economic Growth, Convergence and Innovation in the EU Regions. Discussions on Estonian Economic Policy: Theory and Practice of Economic Policy. Vol 20, No 1 (2012), 105-121.

[31] Paas, Tiiu; Raul Eamets; Jaan Masso; Marit Rõõm (2003) Labour Market Flexibility and Migration in the Baltic States: Macro Evidences, Working Paper Series of the University of Tartu, Faculty of Economics and Business Administration, Number 16, Tartu.

[32] Tanning, Lembo; Tanning, Toivo (2019). Sryahva. International Journal of Emerging Engineering Research and Technology. USA. Vol. 7, Issue 10, p. 21-29.

[33] Tanning, Lembo (2019). Regression Analysis of Economic Key Indicators of the European Union Countries. American Institute of Science. American Journal of Business and Society. Boston. USA. Vol. 4, No. 1, p. 32-43.

[34] Tanning, Lembo (2019). Reflections on the construction of a new railway in the Baltic States. Sryahva. Journal of Architecture and Construction. Delaware. USA. Vol. 2, Issue 1, p. 6-22.

[35] Tanning, Lembo; Tanning, Toivo (2018). European Union Versus United Kingdom Based on the Economy. International Technology and Science Publications. Management. London. Vol. 2, Issue 1, p 24-38.

[36] Tanning, Lembo; Tanning, Toivo (2018). Polish and Baltic States Passenger Transport Analysis. American Institute of Science. American Journal of Business and Society. Boston. USA. Vol. 3, No 2, p. 58-71.

[37] Tanning, Lembo (2018). Analysis of Railway Transport Efficiency of the Baltic States. American Institute of Science. American Journal of Business and Society. Boston. USA. Vol. 3, No 4, p. 81-96.

[38] Tanning, Lembo; Tanning, Toivo (2018). Labour Productivity Dynamics Regularities Analyses by Manufacturing in European Union. Academic Research Publishing Group. International Journal of World Policy and Development Studies. Vol. 5, No 1, p. 1-11.

[39] Tanning, Lembo; Tanning, Toivo (2018). Central and Eastern European Countries Value Added Analysis. American Institute of Science. American Journal of Business and Society. Boston. USA. Vol. 3, No 2, p. 38-57.

[40] Tanning, Toivo; Tanning, Lembo (2014). Labour productivity trends analyses in Baltic countries to 2014. International Journal of Economic Theory and Application. American Association for Science and Technology. USA, 1 (3), 35−42.

[41] Tanning, Toivo (2017). Contradictions are the basis for development. GISAP: Economics, Jurisprudence and Management. IASHE. London.

[42] Tanning, Lembo & Tanning, Toivo (2014). Labour Productivity Analyses of Gross Value Added and Turnover Per Person Employed of Transportation Companies of European Countries in 2005-2011. International Journal of Economic Theory and Application: American Association for Science and Technology, 1, 9−18.

[43] Tanning, Lembo & Tanning, Toivo (2014). Labour Productivity of Transportation Enterprises by Turnover per Person Employed Before and After the Economic Crisis: Economic Crisis Lessons from Europe. American International Journal of Contemporary Research, 4 (1), 52−76.

[44] Tanning, Lembo & Tanning, Toivo (2014). How former post-socialist countries have been the economic crisis? SOP Transactions on Economic Research, USA, 15−33.

[45] Tanning, Toivo; Tanning, Lembo (2014). Material flow efficiency of Central and East European countries of the European Union. Journal of Multidisciplinary Engineering Science and Technology (JMEST), Berlin, Germany, 1, 262−272.

[46] Tanning, Toivo; Tanning, Lembo (2013). An Analysis of Working Efficiency in Central and East European Countries. American Journal of Economics/The Scientific & Academic Publishing, New York, USA, 3 (3), 171−184.

[47] Tanning, Lembo; Tanning, Toivo (2014). Central and Eastern European Countries before and after the 2008 Financial Crisis: Economic Overview and Transportation Companies. Journal of Business Theory and Practice 2 (2), 221.

[48] Tanning, Lembo; Tanning, Toivo (2014). Gross Value Added per Person Analyses of Transportation Companies of new European Union countries in 2005–2011. SOP Transactions on Marketing Research, USA 1 (2), 1-15.

[49] Gross domestic product at current prices, billion PPS. Code: tec00001. Eurostat 22.02.2020 http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tec00001&plugin=1

[50] Production value. Statistical concepts and definitions. Eurostat. https://ec.europa.eu/eurostat/cache/metadata/en/sbs_esms.htm

[51] GDP and main components (output, expenditure and income) [nama_10_gdp] Eurostat. 27-09-2019 http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_gdp&lang=en

[52] GDP and main aggregates - selected international annual data [naida_10_gdp] Gross domestic product at market prices. Current prices, US dollars. Eurostat. 20-12-2019 https://ec.europa.eu/eurostat/data/database

[53] Value added by NACE Rev. 2. Manufacturing. Million EUR. Eurostat. 28.11.2019. https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tin00150

[54] Top 10 largest economies by GDP. Economic Statistics (2018) https://statisticstimes.com/economy/largest-economies-gdp.php

[55] International trade. Code: tet00002. Eurostat. 04 Dec 2019. http://ec.europa.eu/eurostat/data/database

[56] Research and development expenditure, by sectors of performance % of GDP. All sectors. Code: tsc00001. Eurostat. 02 Jan 2020 https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsc00001

[57] Total researchers by sectors of performance - head count. Head count. Eurostat. Code: tsc00003 https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsc00003

[58] High-tech trade by high-tech group of products in million euro (from 2007, SITC Rev. 4). Code: htec_trd_group4. Eurostat. Last update: 21-05-2019 https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_trd_group4&lang=en

[59] High-tech statistics - economic data https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:High-tech_statistics_-_economic_data

[60] Purchases of goods and services. Data: 15-09-2014 https://statistiques.public.lu/en/methodology/definitions/P/achatsbiensservices/index.html

[61] News Release 189/2020 - 16 Dec 2020. Euro area international trade in goods surplus. Eurostat https://ec.europa.eu/eurostat/documents/2995521/10081981/6-17122019-AP-EN.PDF/f230e6d0-fc87-deb1-b8eb-d2c7603623ec

[62] GDP (Purchasing Power Parity) 21-05-2020 https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html

[63] Enterprises in high-tech sectors by NACE Rev.2 activity [htec_eco_ent2] Last update: 02-05-2020 https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_eco_ent2&lang=en#

[64] Economic data in high-tech sectors by NACE Rev.2 activity [htec_eco_sbs2] Last update: 21-03-2020 https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do#

[65] "World Economic Outlook Database, October 2019". IMF.org. International Monetary Fund. 15 October 2019. Retrieved 3 September 2019. Annual Report 2020 https://www.imf.org/