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Reviewing the nomenclature for high-technology – the sectoral approach

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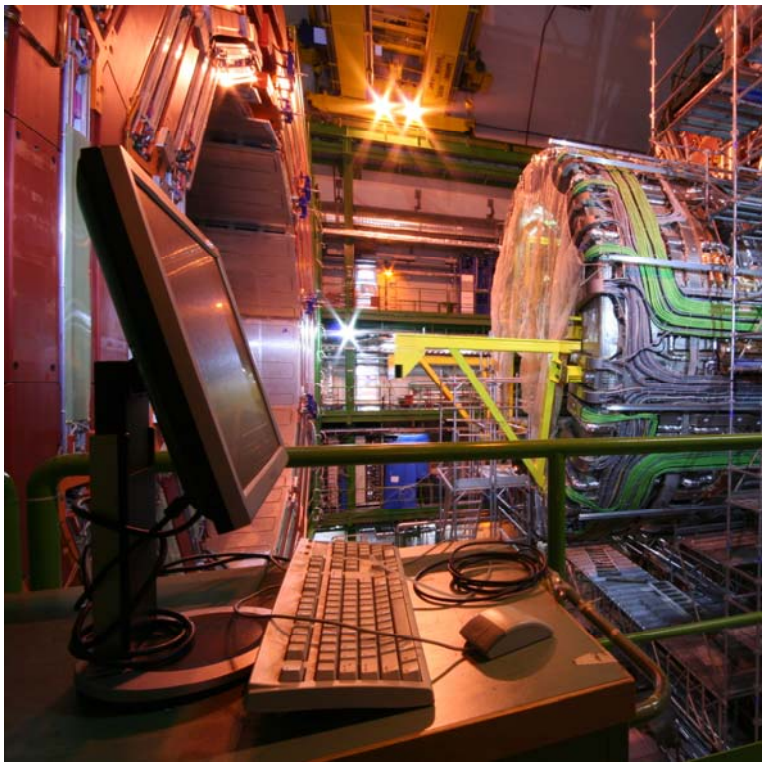

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Reviewing the nomenclature for high-technology – the sectoral approach

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Contents

0. Executive Summary

This report reviews the nomenclature on high-technology using the sectoral approach presented by the OECD in 1997. This nomenclature uses the direct and indirect R&D intensities as the sole criteria for the allocation of the industries to one of the four technology levels.

In contrast to the calculation of the direct R&D intensities, the calculation of the indirect R&D intensities is not a straightforward task as it implies the identification of the R&D embodied in the intermediate goods needed for the production by a specific industry. The OECD calculated the indirect R&D intensities using the Input-Output tables of the year 1990 from 10 countries. Considering the technological evolutions since 1990 and considering the limited number of countries used for the calculation at that time, an urgent need to review the nomenclature was identified by Eurostat and the Joint Research Centre.

The present report gives the definition of high-technology used in the investigation, names the data sources used and pinpoints the limitations found in the data. It describes the calculation process of the direct and indirect R&D intensities using the Input-Output tables of the year 2005 from 25 countries. The results of the calculation are analysed shortly and an outlook on future work is given.

1. Introduction

High-tech nomenclatures are of great importance for the analysis of foreign trade. Although high-technology sectors only account for about 10% of manufacturing gross value added, they account for about 35% of the world exports.[1] The current nomenclature on high-technology stems from an investigation done by Thomas Hatzichronoglou presented in 1997 by the OECD.[2] Hatzichronoglou constructed the nomenclature using the (direct and indirect) research and development (R&D) intensities of the economic sectors as the sole indicator to identify technology intensive sectors. This nomenclature was since then only slightly updated in 2001 using only direct R&D intensities,[3] i.e. the 2001 update did not consider the R&D embodied in the intermediate goods.

Therefore, an urgent need for a review of this nomenclature has been identified by Eurostat and the Joint Research Centre. This report concentrates on the so called 'sectoral approach' for the classification of high-technology and presents the results of this investigations by the JRC using data with the reference year 2005 which became available in 2009.[4] This is the second review of the nomenclature by the JRC; a paper which presented intermediate results of the JRC's investigation based on data from the reference year 2000 was presented in 2008 at the OECD.[5] Therefore, this report will only concentrate on the results using the newest data.

2. Definition of high-technology

High-technology is usually defined via the R&D expenditure in relation to the production output or to the valued added.[6] This ratio is called R&D intensity.

In this report the R&D intensities have been calculated for each industry taking into account the direct R&D intensity and the indirect R&D intensity in ratio with the production output. The indirect R&D intensity is the R&D expenditures embodied in the intermediate products coming from other sectors used in the production of the economic sector under study.

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[1] Based on own calculations for the year 2000 using mainly data from the OECD's input-output tables and UN's Comtrade database. For further information on the manufacturing in the OECD countries, including information on the high-tech sectors, see: Pilat, Dirk; Cimper, Agnès; Olsen, Karsten; and Webb, Colin (2006), "The Changing Nature of Manufacturing in OECD Economies" in: OECD Science, Technology and Industry Working Papers, 2006/9.

[2] Hatzichronoglou, Thomas (1997), "Revision of the High-Technology Sector and Product Classification" in: OECD Science, Technology and Industry Working Papers, 1997/2.

[3] Under the assumption that by considering also indirect R&D intensities only the ranking within the technology groups changes, the original classification by Hatzichronoglou (1997) was updated using only direct R&D intensities. See: OECD (2005) Handbook on Economic Globalisation Indicators, p. 172.

[4] Also the product approach of identifying the trade with high-tech was recently updated: Eberth, Florian (2008), "Increasing the Relevance of Trade Statistics: Trade by High-Tech Products", paper presented at the 1st Meeting of the Working Party on International Trade in Goods and Trade in Services Statistics (WPTGS) of the OECD in September 2008.

[5] Loschky, Alexander (2008), "Reviewing the nomenclature for high-technology trade – the sectoral approach", paper presented at the 1st Meeting of the Working Party on International Trade in Goods and Trade in Services Statistics (WPTGS) of the OECD in September 2008.

[6] High-technology could also be defined considering indicators like the number of patents per year in a certain area or the number of R&D personnel or personnel with a university degree in relation to the total number of employees in a certain economic sector. However, these indicators do not represent monetary values and therefore comparison with the output is not straightforward.

3. Data sources used

The sectoral approach applied by the JRC uses the R&D intensity in the economic sector in question to classify industries by its technology intensiveness. The R&D expenditure data comes from OECD's *Analytical Business Enterprise Research Development (ANBERD) Database* included in the current edition of the STructural ANalysis (STAN) Database (2009 edition).[7]

The investigation by the JRC not only took direct R&D intensities into account but also the indirect R&D intensities which were calculated using the OECD's harmonised Input-Output tables. The current 2009 edition of the OECD's harmonised Input-Output tables covers 26 OECD Member States and 5 non-member countries with I-O tables of the year 2005 or sufficiently close to 2005. Data from 25 countries – for which both Input-Output tables and R&D expenditure data were available with sufficient quality and level of detail – could be used to classify the economic sectors by technology:[8] Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Mexico, the Netherlands, Poland, Portugal, Slovenia, South Korea, Spain, Sweden, Turkey, the United Kingdom, and the United States. [9] This represents a very significant increase in the data basis compared to the original nomenclature which included only data from ten countries and also compared to the OECD's update of the year 2001 which used data from 12 countries. The trade volume (imports + exports) of the 25 countries used for the revision of the nomenclature presented in this report covers 67% of the world trade volume.

As the basis for the calculation is a lot wider now than it was when the current used high-tech nomenclature for the sectoral approach was adopted, one might expect some changes in the classification and the ranking of the industries solely due to the increase in the data availability (and not because the high-technology content has risen or fallen). A calculation to assess the impact of the new countries on the classification has been performed and the result was that the increase in the number of countries did not have a significant impact on the classification of the industries by technology level. It seems that the number of countries only has an influence on the decision to classify some industries as medium-low-tech or low-tech. The classification of industries as medium-high-tech or high-tech is not influenced by the inclusion of new countries.

[7] ANBERD R-3 data series (i.e. data based on ISIC Revision 3 classification) presents Industrial R&D expenditure data with sufficient detail for 34 OECD members and non-members.

[8] The limiting factor was mainly the availability of data on R&D expenditure.

[9] The countries listed include all OECD countries except for Iceland, Norway, the Slovak Republic, and Switzerland and one non-OECD-member country Slovenia.

4. Calculation method for the (direct and indirect) R&D intensities

The calculation of the total R&D intensities which include the direct R&D intensities and the R&D embodied in the intermediate products used for the production of the final products of the economic sector under study (indirect R&D intensities), is relatively complex. In the following, the calculation process used in the investigation by the Joint Research Centre is outlined in nine brief steps[10]:

1. The most up-to-date input-output tables from the year 2005 (or a year close to it)[11] were converted from the respective national currencies into United States Dollars using purchasing power parities (PPP). Subsequently, the service sectors in these tables were compressed into a single column / line in order to make further calculations less complex and in order to avoid problems originating from data gaps in the R&D data of the service sectors. It has to be noted that the Input-Output tables do not cover all ISIC Rev. 3 economic sectors but are less detailed and use their own IO industry classification. However, this classification can subsequently be transferred into ISIC Rev. 3 using a concordance table[12].

2. In many countries some important economic sectors lack data availability and are shown together with other economic sectors: examples are the *pharmaceuticals* industry which is shown together with the *chemicals* industry (in 20 countries), or the *ships*, *aircrafts*, and *railroad equipment* industries shown as one sum (in 19 countries).[13] These are only examples, but they show the important limitations of the Input-Output tables available from the OECD as for instance aircrafts are classified as high-tech, railroad equipment as medium high-tech and ships as medium-low-tech. Therefore, where possible, the data combining various industries was split up and estimated using production data of the year 2005 (or a year close to it). The production data was used to determine the shares of each industry in the economic output. Unfortunately, this was not possible for all economic sectors in all countries and estimates are only available for the total output and not for intermediate

[10] The methodology used by the JRC for the calculation of the direct and indirect R&D intensities is based on an earlier work by Hatzichronoglou (1997). For a general paper on the use of Input-Output for the analysis of the internationalisation of economic value creation see: Wixted, Brian; Yamano, Norihiko; and Webb, Colin (2006): Input-Output Analysis in an Increasingly Globalised World: Applications of OECD's Harmonised International Tables, OECD Science, Technology and Industry Working Papers, 2006/7.

[11] Input-Output tables (industry-by-industry, basis prices) from the year 2005 were available for 19 countries: Austria, Canada, the Czech Republic, Germany, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Japan (commodity-by-commodity), the Netherlands, Poland, Portugal, Slovenia, South Korea (producer's prices), Spain, Sweden, and the USA (producer's prices). For Australia the I-O table was available for the period 2004/2005. I-O tables from the year 2004 were available for two countries: Belgium and Poland. I-O tables from the year 2003 were also available for two countries: Mexico and the United Kingdom. For Turkey an I-O table was available for the year 2002. Countries with I-O tables prior to 2002 were not considered in the calculation. China had data available for the year 2005, but large data gaps and the unavailability of production data for the estimation of certain important industries led to the exclusion of China from the calculation.

[12] A concordance table can be found in Yamano, Norihiko and Ahmad, Nadim (2006): The OECD Input-Output database: 2006 edition; STI working paper 2006/8, p. 12.

[13] The pharmaceutical industry is included in the chemical industry in Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Portugal, Slovenia, South Korea, Spain, Sweden, the United Kingdom, and the USA. The ship, aircraft, and railroad industries are shown as one sum in Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Portugal, Slovenia, Spain, Sweden, the United Kingdom, and the USA.

products.[14] However, the remaining error was considered to be small enough so as not to influence the final result.

3. In the next step the 25 Input-Output tables were summed up to a single Input-Output table. As the aim of this study is to calculate the R&D intensities, a summary table was regarded to give sufficiently precise results. A more complex way to calculate the R&D intensities would have been to use a system of linked Input-Output tables using also information from the input matrices. However, such a system of Input-Output tables is not readily available and the creation of such a system would have been out of the scope of the project.

4. In order to calculate the direct R&D intensities, the total R&D expenditures of each sector of all 25 countries were divided by the total output of each sector. These R&D intensities were calculated using R&D expenditure data from the year 2005 (or the nearest years to that). When output data from the Input-Output table was not available for a specific economic sector, estimates were used where possible (see step 2).

5. The summary Input-Output table of step 3 was converted into a table of input coefficients (showing the amount of intermediate products of sector X needed in the production of sector Y).

6. This matrix of input coefficients was subtracted from the unit matrix and then inverted giving the Leontief inverse (showing the impact of one unit of final demand on the intermediate products).

7. The Leontief inverse was then transformed into a table of output necessities (showing the amounts of intermediate products needed for one unit of output) by dividing the intermediate inputs from sectors X for sector Y by the output of sector Y. The diagonals (inputs from the same sectors Y) were omitted in order to avoid double counting of the R&D intensities.

8. The output necessities of sector Y from other sectors X were multiplied with the respective R&D intensities of sectors X (calculated in step 4) resulting in the indirect R&D intensities of sector Y originating from the various sectors X providing intermediate products. The results of these multiplications were then added together giving the total indirect R&D intensity of sector Y. This value represents the share of R&D embodied in the intermediate products needed in the production of the goods of the respective economic sector. The total R&D intensity of sector Y was produced adding the indirect R&D intensities of sector Y to the direct R&D intensity of Y.

9. The total R&D intensities were then used to classify each sector for its technology intensiveness. The thresholds used were:

    - R&D intensity is below 1.0%: low-tech
    - R&D intensity is between 1.0% and 2.5%: medium-low-tech
    - R&D intensity is between 2.5% and 8%: medium-high-tech
    - R&D intensity higher than 8%: high-tech

    These thresholds are the same as in previous revisions of the nomenclature.

[14] As a result, some economic sectors show embodied R&D intensities which are too high, especially for the chemical products and the shipbuilding sector. As a consequence, some other economic sectors show embodied R&D intensities which are too low.

5. Results

The high-tech sectors could be clearly identified, as their direct R&D intensities (and hence also their total R&D intensities) were clearly above the threshold of 8%. The industries identified as high-tech sectors are the *Pharmaceuticals* industry, the *Medical, precision & optical instruments* industry, the *Radio, television & communication equipment* industry, the *Aircraft & spacecraft* industry, and the *Office, accounting & computing machinery* industry. (For more details on the R&D intensities refer to Table 1 on the following page.)

The identification of the medium-high-tech sectors was somehow less precise as especially the *Chemical products (excl. pharmaceuticals)* sector was only slightly below the threshold of 2.5%. This industry has been traditionally classified as a medium-high-tech industry and was now downgraded to medium-low-tech due to its decrease in R&D intensity over the years. However, considering the relatively high direct R&D intensity of almost 2%, this industry could also as well remain in the medium-high-tech level if the threshold between medium-high and medium-low-tech had been adjusted to 2.3%.

According to the calculation of the R&D intensity, the *Building & repairing of ships & boats* industry should have been classified as a medium-high-tech industry, but considering that in a number of countries the *Aircraft & Spacecraft* and the *Railroad equipment* industry are listed together with the shipbuilding industry, the direct and indirect R&D intensities of the shipbuilding industry are too high. Looking at the components of the total R&D intensity it can be said that the indirect R&D intensity of the shipbuilding industry is definitively too high as it was not possible to distribute and estimated the intermediate products on the aircrafts and railroad industries. Also the direct R&D intensity of the shipbuilding industry is probably too high, because for some countries it was also not possible to distribute and estimate the total output of the aircraft and the railroad industry. As a consequence, the *Building & repairing of ships & boats* industry was classified by the JRC as a medium-low-tech industry although the total R&D intensity was considerably above the threshold of 2.5%. The necessary reclassification of this industry was the only “manual” modification of the nomenclature in the revision process.

Furthermore, five industries had R&D intensities very close to the threshold between the medium-low-tech and the low-tech sector: the *Coke, refined petroleum products and nuclear fuel* industry, the *Iron & steel* industry, the *Food products, beverages and tobacco* industry, the *Textiles, textile products, leather and footwear* industry (all four classified as low-tech), and the *Pulp, paper, paper products, printing and publishing* industry (classified as medium-low-tech). The first and the second were previously classified as medium-low-tech and are now low-tech, the third and the forth did not change their classification as a low-tech industry, and the fifth, previously a low-tech industry, is now classified as medium-low-tech.

In conclusion, compared to the classification updated in 2001 by the OECD (where the scientific instruments / precision instruments were promoted to high-tech) there were no changes in the classification of the high-tech industries. However, the ranking within the high-tech group has changed.

In the medium-tech groups there was an important change: The *Chemicals (excluding pharmaceuticals)* industry was downgraded from medium-high-tech to medium-low-tech. However, as it was pointed out earlier, this decision is disputable.

The highest number of changes was between the medium-low-tech and the low-tech sectors where three industries changed their classification.

Table 1: Classification of industries based on technology intensity

Nomenclature			2005 (data from 25 countries)			2000 (data from 18 countries)			1990* (data from 10 countries)			1980* (data from 10 countries)		
tech level	IO sector / Sector description	ISIC Rev. 3	Rank	dir.+indir. R&D	dir. R&D	Rank	dir.+indir. R&D	dir. R&D	Rank	dir.+indir. R&D	dir. R&D	Rank	dir.+indir. R&D	dir. R&D
High-tech	10 Pharmaceuticals	2423	1	15.08%	14.29%	2	10.94%	10.04%	3	11.35%	10.47%	4	8.37%	7.62%
	20 Medical, precision & optical instruments	33	2	11.85%	10.27%	1	12.38%	10.53%	5	6.55%	5.10%	5	4.69%	3.61%
	19 Radio, television & communication equipment	32	3	11.83%	10.72%	3	9.53%	8.32%	4	9.40%	8.03%	3	9.33%	8.35%
	23 Aircraft & spacecraft	353	4	10.06%	9.37%	5	8.79%	8.21%	1	17.30%	14.98%	1	16.06%	14.13%
	17 Office, accounting & computing machinery	30	5	9.17%	8.09%	4	8.99%	7.91%	2	14.37%	11.46%	2	11.19%	9.00%
Medium-high- tech	24 Railroad equipment & transport equipment n.e.c.	352 + 359	6	5.63%	4.08%	6	5.09%	3.68%	9	3.03%	1.58%	11	1.69%	0.98%
	21 Motor vehicles, trailers & semi-trailers	34	7	4.09%	3.09%	7	4.28%	3.30%	6	4.44%	3.41%	7	3.68%	2.81%
	18 Electrical machinery & apparatus, n.e.c.	31	8	3.32%	2.19%	8	3.79%	2.65%	7	3.96%	2.81%	6	4.25%	3.48%
	16 Machinery & equipment, n.e.c.	29	9	3.27%	2.22%	9	3.31%	2.13%	10	2.58%	1.74%	10	2.00%	1.32%
Medium-low-tech	09 Chemicals excluding pharmaceuticals	24 ex. 2423	10	2.38%	1.92%	10	2.88%	2.38%	8	3.84%	3.20%	8	2.67%	2.15%
	11 Rubber & plastics products	25	11	2.29%	1.02%	11	2.37%	1.03%	11	2.47%	1.07%	9	2.20%	1.08%
	22 Building & repairing of ships & boats	351	12	4.22%	2.61%	12	2.34%	0.73%	12	2.21%	0.74%	13	1.42%	0.39%
	25 Manufacturing n.e.c.; recycling	36 + 37	13	1.52%	0.57%	15	1.42%	0.46%	13	1.76%	0.63%	12	1.45%	0.79%
	12 Other non-metallic mineral products	26	14	1.33%	0.66%	14	1.49%	0.80%	15	1.44%	0.93%	14	1.10%	0.66%
	15 Fabricated metal products, except machinery & equipment	28	15	1.22%	0.42%	16	1.36%	0.54%	16	1.35%	0.63%	15	1.06%	0.45%
	14 Non-ferrous metals	272 + 2732	16	1.21%	0.69%	13	1.54%	0.80%	14	1.57%	0.93%	16	1.04%	0.54%
	07 Pulp, paper, paper products, printing and publishing	21 + 22	17	1.02%	0.46%	19	0.99%	0.40%	19	0.88%	0.31%	19	0.68%	0.23%
Low-tech	05 Textiles, textile products, leather and footwear	17 + 18 +19	18	0.98%	0.35%	20	0.97%	0.29%	20	0.78%	0.23%	20	0.56%	0.13%
	04 Food products, beverages and tobacco	15 + 16	19	0.96%	0.38%	21	0.96%	0.34%	21	0.73%	0.34%	20	0.56%	0.14%
	13 Iron & steel	271 + 2731	20	0.96%	0.42%	17	1.14%	0.53%	18	1.10%	0.64%	18	0.78%	0.45%
	08 Coke, refined petroleum products and nuclear fuel	23	21	0.87%	0.28%	18	1.11%	0.39%	17	1.33%	0.96%	17	0.80%	0.58%
	06 Wood and products of wood and cork	20	22	0.76%	0.16%	22	0.83%	0.21%	22	0.65%	0.18%	22	0.55%	0.14%

*: Data for the years 1990 and 1980 are taken from Hatzichronoglou (1997) for reference. Data of the 2001 update using only the direct R&D intensities of the year 1999 (12 countries) are not shown here.

6. Implications from the increasing globalisation in trade and research

Apart from the sectoral approach primarily discussed here and the product approach, there is a new approach known as *high-tech trade by enterprise characteristics* (first presented in November 2009[15]) which gives very interesting results. This approach allows identifying the goods which are actually traded by the high-tech industries and identifying the share of the high-tech industries in the total trade with high-tech products. This is done by using so-called *external trade data by enterprise characteristics* or *sectoral foreign trade data.* This sectoral foreign trade data set – produced by Eurostat in non-mandatory co-operation with the EU Member States – combines foreign trade data with enterprise related data from the general business register of each country.[16] The resulting data contains information on the products (by CPA 2 digit), the economic sector of the companies (by NACE), the number of employees, the turnover, etc..

For the investigation of the foreign trade by technology groups, the available combination of NACE and CPA data was unfortunately not detailed enough. Therefore, the JRC together with Eurostat and in co-operation with a large number of EU Member States conducted a pilot study combining business register data with foreign trade data on the highest level of detail, the 6-digit level of the Harmonised System (HS).

The first results of this pilot study showed that the share of high-tech goods in the exports of the high-tech industries is lower than 50%. Looking at the same issue from another viewpoint reveals another interesting fact: the share of the high-tech industries in the total exports of high-tech goods is also only 53% but with a significant difference between the intra-community trade (Intratrade) and the extra-community trade (Extratrade): In Intratrade the share of the high-tech industries in the export of high-tech goods was only 42% whereas in Extratrade it was 76%. The relatively low participation of the high-tech industries in the exports of high-tech goods to other EU Member States can be interpreted as a sign of a high degree of division of labour within the EU. Although this study only covered the trade of the European Union, this conclusion might also hold for the intra-regional trade of other economic areas, like NAFTA or MERCOSUR.

The high degree of division of labour in the production of (high-tech) goods is only one symptom of the globalisation. Similar to the division of labour in the production also the research and development is increasingly geographically dispersed. This is already a fact among the developed countries but is also becoming a reality on a global scale.

Therefore, the inclusion of developing countries in the calculation of the R&D intensities is increasingly important and using data only from OECD Member States and other developed countries can distort the picture. On the other hand, including data from big developing economies like China or India can also cause problems: During the review of the high-tech nomenclature a first test to include data from the largest developing country, China, was conducted. Although the Chinese data showed some large data gaps in R&D and in production/output data – which made it impossible to use the data in the review of the high-tech nomenclature – some conclusions from this test can be drawn.

[15] Loschky, Alexander; Nuortila, Karo (2009): High-tech trade by enterprise characteristics, paper presented at the 2nd OECD WPTGS meeting (16-18 November 2009).

[16] For the methodology see: Eurostat (2005): External trade by activities and size-classes of enterprises, Eurostat Working Papers and Studies, Luxembourg: Office for Official Publications of the European Communities.

The inclusion of data from developing countries can change the classification of some industries. Looking at the Chinese data, it can be seen that the direct R&D intensities for all Chinese industries are lower than 1.25%. The Chinese industry with the highest R&D intensity is the *Office, accounting & computing machinery* industry, which in the case of China also includes the *Radio, television & communication equipment* industry. Both industries are classified as high-tech sectors when China is not considered. Including the Chinese data, the *Office, accounting & computing machinery* industry becomes downgraded from a high-tech industry to a medium-high-tech industry with a total R&D intensity of only 3.9%. (The *Radio, television & communication equipment* industry is not affected by the Chinese data, as this industry is listed under the computing machinery industry in China.)

This means, that including countries with a very high production and relatively little research can also adversely affect the classification or can lead to modifications in the thresholds.

7. Conclusions and future work

The recalculation of the direct and indirect R&D intensities in order to allocate the industries to one of the four technology levels showed that the composition of the technology groups is quite stable over time.

In fact, there were no major changes in the medium-high-tech and high-tech sectors compared to the data from 1990 except for the promotion of the *Medical, precision & optical instruments* industry from the medium-high-tech sector to the high-tech sector in the 2001 review by the OECD and for the downgrading of *Chemicals (excl. Pharmaceuticals)* from medium-high-tech to medium-low-tech in the present review.

Within the technology groups however, the ranking of the industries changed considerably, in particular in the high-tech sector: the *Pharmaceuticals* industry is now the industry with the most R&D intensive production, whereas the *Aircraft & spacecraft* industry – which used to be the industry with the highest R&D intensity – faced significant decreases in their R&D intensiveness and hence in the ranking.

Although the present report uses the most up-to-date, the review of the nomenclature should be repeated again as soon as the circumstance allow for it. There are a series of reasons for this:

- The industry classifications were recently updated. The international ISIC nomenclature Revision 4 was released in August 2008 and the European nomenclature NACE Rev. 2 (which is based on ISIC Rev. 4) is to be used, in general, for statistics referring to economic activities performed from 1 January 2008 onwards. While these new nomenclatures are already used by Eurostat for a series of statistics, both sources for the calculation of the high-tech nomenclature the Input–Output tables and the R&D data provided by the OECD are still only available in the old revisions of ISIC / NACE. With a view to the major differences from the old revisions to the new ones – which for our purposes makes it impossible to uses correspondence tables between the two – the nomenclature of high-tech industries should be reviewed again when the Input-Output tables and the R&D data become available in the new ISIC / NACE revisions.

- Considering the increasing importance of international supply and production chains, data from more countries should be included for the calculation of the R&D intensities. Especially including data from developing countries might change the classification of some industries as a test with Chinese data has shown.

- The availability and the possibility to use also other data (number of patents, share of highly-educated personnel, etc.) for the identification of technology intensive industries should be assessed in the next review. The inclusion of the share of highly-educated personnel into the classification could also allow for extending the nomenclature to the services sectors. In contrast to manufacturing sectors, in services the technology intensiveness in terms of intermediate and final goods used is usually relatively low, but the human capital is a very important factor.

For the future, the aim should be to merge the nomenclature of technology intensive manufacturing sectors with the nomenclature of knowledge intensive services. This would allow for a comprehensive tool for the sectoral analysis of foreign trade and other business statistics.

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Abstract
This report reviews the nomenclature on high-technology using the sectoral approach presented by the OECD in 1997. This nomenclature uses the direct and indirect R&D intensities as the sole criteria for the allocation of the industries to one of the four technology levels.
In contrast to the calculation of the direct R&D intensities, the calculation of the indirect R&D intensities is not a straightforward task as it implies the identification of the R&D embodied in the intermediate goods needed for the production by a specific industry. The OECD calculated the indirect R&D intensities using the Input-Output tables of the year 1990 from 10 countries. Considering the technological evolutions since 1990 and considering the limited number of countries used for the calculation at that time, an urgent need to review the nomenclature was identified by Eurostat and the Joint Research Centre.
The present report gives the definition of high-technology used in the investigation, names the data sources used and pinpoints the limitations found in the data. It describes the calculation process of the direct and indirect R&D intensities using the Input-Output tables of the year 2005 from 25 countries. The results of the calculation are analysed shortly and an outlook on future work is given.

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