**Review of Socio-Economic Perspectives** **Juchniewicz, M. pp. 95-106**
**Vol. 3. Issue: 2/ December 2018**

**DOI:** 10.19275/RSEP053
***Received:*** *16.09.2018*
***Accepted:****20.11.2018*

# DIVERSITY OF PRODUCTION POTENTIAL OF ADVANCED TECHNOLOGY SECTOR WITHIN THE EU COUNTRIES

**Małgorzata Juchniewicz**
*Prof, University of Warmia and Mazury in Olsztyn, Poland,*
*malgorzata.juchniewicz@uwm.edu.pl*

**Abstract**

From many years there is a significant growth of meaning of the sector of advanced technology in national economies. Enterprises which belong to this sector are intensively using the knowledge, are the source of inventions, innovations, produced and used by them technologically advanced goods are determining the effectiveness of the whole economy. It decides mainly in a large degree about a possibility of competing in a global scale, not only by the enterprises but as well of regions and nations. For this reason, research problem was about determining the degree of differentiation of production potential of the sector of advanced technology within EU countries. From the conducted research it follows that the biggest number of subjects and hired people within this sector are in the western Europe. In the lead are Great Britain, France and Germany.

***Keywords:*** Advanced technology industry, production potential, European Union

***JEL Classification:*** O33, O52, P16

**Citation:** Juchniewicz, M. (2018) Diversity of production potential of advanced technology sector within the EU countries, Review of Socio-Economic Perspectives, Vol 3(2), pp. 95-106, 10.19275/RSEP053

## 1. Introduction

The source of competitive advantage of countries realizing innovative model of economic growth is usage of the leading technologies and production of products characterized by the highest quality. The innovative economic growth is involved by the most economically advanced countries of the world. Due to this fact they get additional impulses for the making of the competitive advantage and strengthening their leading position in global economy. Therefore, production of advanced technology industries did significantly improve in the past decades, and the high-tech products are the fastest growing sector of international trade (Srholec, 2007, p. 250). Lee and Tang (2013, p.18) claim that the sector of advanced technologies is the key factor to gain the long-term economic growth and keeping the permanent competitive advantage. Besides that, in the literature of subject there are some controversial results of research (Varum et al., 2009, p. 405) in this area the meaning of the advanced technologies sector is widely accepted. Fagerberg (2000, pp. 393–411) and Michael (2003, pp. 427-448) stated that within the countries which were able to increase the share of advanced technology sector the bigger growth of productivity was noted in comparison to other countries. Nordhaus (2005, p.5) and Bogliacino et al. (2012, p. 57) are adding that besides that it is connected with the higher than in the other sectors, intensity of research and development works. Similar approach is presented within the European Report of Competitiveness (EC, 2013, p. 20), in which the meaning of this sector in the process of building the competitiveness of European economy is highlighted. Harbi et. al. (2009, pp. 465-480) claim also that the sector of advanced technology may be the important factor of the growth of less evolved countries. Gomułka (2015, p. 394) point out the significant meaning of diversity between the national economies and resulting from them conditions which include the possibilities of growth in dependence of the level of technological advancement. He highlights that the growth of GDP *per capita* in the most technologically advanced countries subjected to fluctuation, but this trend also may be found as stable and common for all of those countries which may indicate the slight small dependence from the economic policy. He also concludes that the growth of GDP *per capita* in countries of less advanced technology was diverse and unstable in time, what may be connected with its dependence from economic policy. Notes he also, that within the countries which are technologically well developed, the capital and labor costs and the work for research and education were growing few times faster than expenditures for the conventional production which as a consequence did influence the "technological revolution". He also highlights that expenditures for research and education have the main meaning for long-term growth of economy and have the quality character. As a consequence, he claims that within the global economy there was visible growth of its duality, which projected on the phenomenon of development divergence between high and less technologically advanced countries. Presented evidence of the meaning of the sector of advanced technology in the economic development of countries were the impulse to conduct the research which aimed to determine the diversity of production potential of the sector of advanced technology within the EU countries.

## 2. Research methodology

Scope of the research was the sector of advanced technology which included the enterprises of high technology and as well the services which are high – tech. To the sector of high technology were included: production of basic pharmaceutical substances and medicines and other pharmaceutical products, computer productions, electronic and optical products, making of the aircrafts, spacecrafts and similar to that machines. High tech services were: the activity connected with the production of the movies, video recordings, TV recordings, sound and music recordings as well with movies, broadcasting of public and subscribed programs, telecommunications, software and advisory activities in the field of computer science and related activities, information service activities, research and development works.

Production potential of sector may be considered by the use of many measures. In this article the most common in the literature were used which are: the number of subjects, number of hired and value of production generated within the sector of advanced technologies. In this study, guided by the possibility of access to the empirical data, the most actual results about analyzed sector were used. The source of such information were data from Eurostat base.

The level of production potential of the sector of advanced technology within EU countries was evaluated by the use of two parameters of taxonomic meter which are: arithmetic average ($\overline{x}$) and standard deviation (S) of accepted indicators. The results were divided into four groups:

- countries of high level of diagnostic variable: $W \geq \overline{x} + S$,
- countries of medium level of diagnostic variable: $\overline{x} + S > W \geq \overline{x}$,
- countries of low level of diagnostic variable: $\overline{x} > W \geq \overline{x} - S$,
- countries of very low level of diagnostic variable: $W < \overline{x} - S$.

Indicators of the dimension of production potential of advanced technologies sector were the basics of creation of classification of EU countries. It was made by the determination of the development pattern – of abstraction country which was characterized be the highest level of presented diagnostic variables. Next the distance of every country was measured according to the formula:

$$d_i = \sqrt{\frac{\sum_{j=1}^{m} (z_{ij} - z_{0j})^2}{m}}$$

where: $d_i$ – distance between country and pattern, $z_{0j}$ – maximum value of the variable j, m – number of variables. Obtained results were converted by the use of following formula:

$$W = 1 - \frac{di}{\max\{d_i\}}$$

where: W – the level of indicator for the accepted level of dimensions of production potential which is the number of subjects, number of employment and value of production of the advanced technology sector. It enabled the presentation of data in a way that bigger values testified about more favorable level of analyzed phenomenon (the country which is a pattern will always get value 1).

## 3. Results of the research and discussion

Production resources of advanced technology sector within the EU countries, identified by the number of subjects and involved labor resources were diverse. There is significant concentration within few countries. The total share of four biggest countries (Great Britain, France, Germany and Italy) in terms of the number of enterprises of advanced technology sector was during the 2012-2014 in the average of 51,61% (table 1). The average level of the number of subjects of the advanced technology sector was in Netherlands, Poland, Sweden and Spain. Share of these countries in the number of enterprises of researched sector was almost over 2-times lower than the previous mentioned. It is worth to highlight that altogether they were about 76,53% of the subjects of advanced technology sectors within the EU countries. The number and share of the enterprises of this sector within the rest of the countries was relatively small.

**Table 1**. The number of subjects of advanced technology within the EU Countries.

| Lp. | Specification | The number of subjects of advanced technology in year: | | | Average during 2012-2014 | Share during 2012-2014 (%) | Level | Total percentage |
|---|---|---|---|---|---|---|---|---|
| | | 2012 | 2013 | 2014 | | | | |
| 1 | European Union (28 countries) | - | 1 016 440 | - | - | - | - | - |
| 2 | United Kingdom | 162 896 | 176 069 | 186 761 | 175 242 | 17,34 | high | 51,61 |
| 3 | France | 119 072 | 130 856 | 144 825 | 131 584 | 13,02 | | |
| 4 | Germany | 100 724 | 105 609 | 121 397 | 109 243 | 10,81 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | Italy | 106 235 | 104 362 | 105 837 | 105 478 | 10,44 | | |
| 6 | Netherlands | 64 095 | 82 647 | 86 026 | 77 589 | 7,68 | medium | 24,92 |
| 7 | Poland | 64 009 | 68 831 | 76 741 | 69 860 | 6,91 | | |
| 8 | Sweden | 53 845 | 53 851 | - | 53 848 | 5,33 | | |
| 9 | Spain | 49 345 | 49 430 | 52 784 | 50 520 | 5,00 | | |
| 10 | Hungary | 35 053 | 33 444 | 36 679 | 35 059 | 3,47 | low | 23,47 |
| 11 | Czech Republic | 33 965 | 33 992 | 34 900 | 34 286 | 3,39 | | |
| 12 | Belgium | 26 962 | 29 505 | 29 183 | 28 550 | 2,83 | | |
| 13 | Austria | 18 211 | 18 602 | 19 009 | 18 607 | 1,84 | | |
| 14 | Romania | 16 262 | 17 078 | 18 274 | 17 205 | 1,70 | | |
| 15 | Denmark | 14 725 | 15 128 | 15 763 | 15 205 | 1,50 | | |
| 16 | Portugal | 14 674 | 14 890 | 15 194 | 14 919 | 1,48 | | |
| 17 | Slovakia | 12 247 | 12 782 | 14 880 | 13 303 | 1,32 | | |
| 18 | Greece | 12 752 | 12 762 | 12 401 | 12 638 | 1,25 | | |
| 19 | Finland | 9 338 | 9 720 | 9 823 | 9 627 | 0,95 | | |
| 20 | Bulgaria | 8 843 | 9 620 | 10 333 | 9 599 | 0,95 | | |
| 21 | Slovenia | 7 390 | 8 064 | 8 890 | 8 115 | 0,80 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 22 | Croatia | 5 645 | 5 753 | 5 927 | 5 775 | 0,57 | | |
| 23 | Lithuania | 4 410 | 5 106 | 5 465 | 4 994 | 0,49 | | |
| 24 | Estonia | 3 368 | 3 827 | 4 003 | 3 733 | 0,37 | | |
| 25 | Latvia | 2 612 | 3 117 | 4 971 | 3 567 | 0,35 | | |
| 26 | Luxembourg | 1 820 | 1 939 | 2 019 | 1 926 | 0,19 | | |
| 27 | Ireland | - | - | - | - | - | - | - |
| 28 | Cyprus | - | - | - | - | - | - | - |
| 29 | Malta | - | - | - | - | - | - | - |

**Source**: Own calculation based on data from Eurostat http://ec.europa.eu/eurostat/data/database (10 .10. 2018 r.)

Considering the changes of the number of enterprises during the analyzed years the general trend was noted, about slight but systematical growth of their numbers. In the layout of the member countries such phenomenon was inhomogeneous. The biggest growth of the subjects' number of advanced technologies was on Latvia, France and Netherlands and in Germany and Slovenia. It is possible also to indicate the countries in which the number of enterprises of advanced technology was slightly smaller – it was within Greece and Italy. Presented changes did not however influenced the countries ranking.

The important component of production resources of the sector is also the number of hired employees (table 2). The highest positions in this ranking were taken by countries of the highest number of subjects which are: Germany, Great Britain, France and Italy. The total share of these countries in the number of hired within the sector of high – tech was 56.67%. The average level of employment was in Spain and Poland. The level of involvement of labor resources in Spain was 2-times smaller, and in Poland over 3-times smaller than in Germany and Great Britain. In the listed countries during the years 2014-2016 the average workforce hired within advanced technology sector was about 69,52% within the EU countries. Similarly, to the number of enterprises there was noted the gradual growth of employment within the advanced technology industry in the most of EU countries. The biggest change in this range was noted in Croatia, Estonia and Slovakia. Relatively meaningful growth of labor expenditures was in Bulgaria, Austria and Portugal. Presented changes did not affected substantially on the positions of the countries in the ranking of employment and on the potential of production measured like that within the EU countries.

**Table 2**. The number of hired people within the sector of advanced technology in EU countries (thousand people)

| Lp. | Specification | Number of hired people within the sector of advanced technology during year: | | | Average during 2014-2016 | Share during 2014-2016 (%) | Level | Total percentage |
|---|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2016 | | | | |
| 1 | European Union (28 countries) | 8537,8 | 8739,1 | 8899,2 | 8725,4 | 100,0 | - | - |
| 2 | Germany | 1648,4 | 1627,7 | 1670,4 | 1648,8 | 18,90 | high | 56,67 |
| 3 | United Kingdom | 1439,3 | 1489,7 | 1507,3 | 1478,8 | 16,95 | | |
| 4 | France | 1021,5 | 1059,2 | 1062,5 | 1047,7 | 12,01 | | |
| 5 | Italy | 761,4 | 767,5 | 779,5 | 769,5 | 8,82 | | |
| 6 | Spain | 629,1 | 656,0 | 656,6 | 647,2 | 7,42 | medium | 12,85 |
| 7 | Poland | 468,9 | 487,0 | 466,8 | 474,2 | 5,44 | | |
| 8 | Netherlands | 291,8 | 306,0 | 335,0 | 310,9 | 3,56 | low | 30,48 |
| 9 | Czech Republic | 238,2 | 229,2 | 242,0 | 236,5 | 2,71 | | |
| 10 | Sweden | 230,3 | 235,5 | 236,8 | 234,2 | 2,68 | | |
| 11 | Romania | 206,5 | 224,4 | 225,7 | 218,9 | 2,51 | | |
| 12 | Hungary | 193,0 | 196,9 | 223,1 | 204,3 | 2,34 | | |
| 13 | Belgium | 198,6 | 198,6 | 196,7 | 198,0 | 2,27 | | |
| 14 | Austria | 166,9 | 165,7 | 182,5 | 171,7 | 1,97 | | |
| 15 | Denmark | 150,4 | 154,9 | 155,9 | 153,7 | 1,76 | | |
| 16 | Ireland | 138,9 | 147,1 | 150,0 | 145,3 | 1,67 | | |
| 17 | Finland | 143,6 | 142,7 | 138,1 | 141,5 | 1,62 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 18 | Portugal | 122,9 | 123,0 | 125,2 | 123,7 | 1,42 | | |
| 19 | Bulgaria | 97,0 | 112,8 | 116,1 | 108,6 | 1,25 | | |
| 20 | Slovakia | 88,4 | 99,2 | 103,3 | 97,0 | 1,11 | | |
| 21 | Greece | 89,8 | 85,7 | 90,4 | 88,6 | 1,02 | | |
| 22 | Croatia | 48,9 | 51,9 | 57,6 | 52,8 | 0,61 | | |
| 23 | Slovenia | 46,9 | 54,3 | 50,3 | 50,5 | 0,58 | | |
| 24 | Estonia | 28,1 | 32,7 | 34,8 | 31,9 | 0,37 | | |
| 25 | Lithuania | 27,1 | 30,6 | 33,3 | 30,3 | 0,35 | | |
| 26 | Latvia | 29,8 | 29,5 | 27,9 | 29,1 | 0,33 | | |
| 27 | Malta | 11,1 | 10,7 | 11,4 | 11,1 | 0,13 | | |
| 28 | Cyprus | 10,5 | 10,5 | 10,7 | 10,6 | 0,12 | | |
| 29 | Luxembourg | 10,5 | 10,1 | 9,3 | 10,0 | 0,11 | | |

**Source**: Own calculation based on data from Eurostat http://ec.europa.eu/eurostat/data/database (10.10. 2018 r.)

Level of the resources in sector of advanced technology of EU countries and the right usage of them should find a reflection in obtained production results. The most common result of economic processes is the value of sold production. The share of individual countries of EU in the creation of discussed sector was as well as the number of subjects and employment significantly diverse (table 3). The highest value of production of the sector of advanced technology was noted in Germany, Great Britain and France. To the group of countries of medium level of production value was included Italy, Spain and Netherlands. Total share of listed countries in the union production was 76.30 %. It was the consequence of big involvement of previous mentioned, production resources within this sector.

**Table 3**. Value of sold production of the advanced technology sector within EU countries (mln euro)

| Lp. | Specification | Value of production in the sector of advanced technology in year: | | | Average during 2012-2014 | Share during 2012-2014 (%) | Level | Total percentage |
|---|---|---|---|---|---|---|---|---|
| | | 2012 | 2013 | 2014 | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | European Union (28 countries) | - | - | - | - | - | - | - |
| 2 | Germany | 266 652 | 280 619 | 290 862 | 279 378 | 20,38 | high | 55,39 |
| 3 | United Kingdom | 255898 | 251 887 | 275 255 | 261 013 | 19,04 | | |
| 4 | France | 219608 | 215 308 | 221 656 | 218 857 | 15,97 | | |
| 5 | Italy | 150591 | 146 718 | 142 116 | 146 475 | 10,69 | medium | 20,91 |
| 6 | Spain | 71339 | 69 842 | 69 678 | 70 286 | 5,13 | | |
| 7 | Netherlands | 62770 | 61 208 | 85 394 | 69 791 | 5,09 | | |
| 8 | Sweden | 61697 | : | : | 61 697 | 4,50 | low | 23,70 |
| 9 | Belgium | 47 386 | 50 418 | 52 485 | 50 096 | 3,66 | | |
| 10 | Poland | 33367 | 33 862 | 34 594 | 33 941 | 2,48 | | |
| 11 | Denmark | 31499 | 31 257 | 34 193 | 32 316 | 2,36 | | |
| 12 | Finland | : | : | 26 104 | 26 104 | 1,90 | | |
| 13 | Czech Republic | 24 530 | 22 800 | 22 822 | 23 384 | 1,71 | | |
| 14 | Austria | 20756 | 22 447 | 23 285 | 22 163 | 1,62 | | |
| 15 | Hungary | 21613 | 19 644 | 19 468 | 20 242 | 1,48 | | |
| 16 | Portugal | 12988 | 12 701 | 12 440 | 12 710 | 0,93 | | |
| 17 | Slovakia | 10805 | 10 347 | 10 692 | 10 615 | 0,77 | | |
| 18 | Romania | 9929 | 10 172 | 11 024 | 10 375 | 0,76 | | |
| 19 | Greece | 8087 | 7 623 | 6 934 | 7 548 | 0,55 | | |
| 20 | Slovenia | 4766 | 4 883 | 4 987 | 4 879 | 0,36 | | |
| 21 | Croatia | 3799 | 3 995 | 3 970 | 3 921 | 0,29 | | |

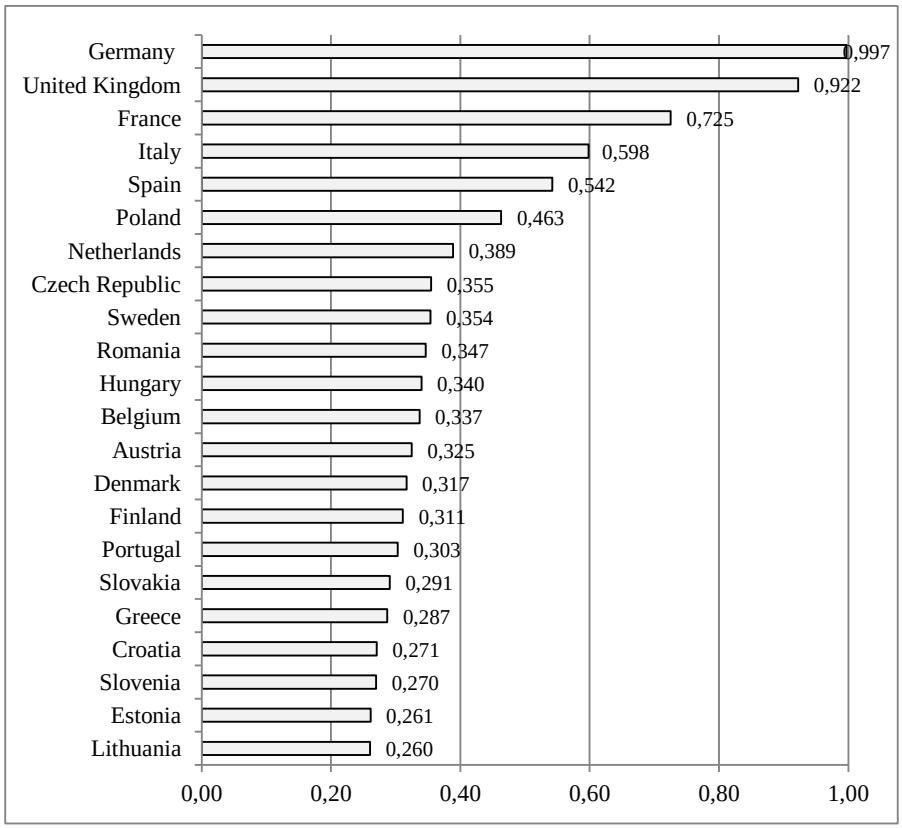
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 22 | Estonia | 3096 | 3 174 | 3 309 | 3 193 | 0,23 | | |
| 23 | Lithuania | 1541 | 1 596 | 1 768 | 1 635 | 0,12 | | |
| 24 | Bulgaria | - | - | - | - | - | - | - |
| 25 | Ireland | - | - | - | - | - | - | - |
| 26 | Cyprus | - | - | - | - | - | - | - |
| 27 | Latvia | - | - | - | - | - | - | - |
| 28 | Luxembourg | - | - | - | - | - | - | - |
| 29 | Malta | - | - | - | - | - | - | - |

**Source**: Own calculation based on data from Eurostat http://ec.europa.eu/eurostat/data/database (10.10. 2018 r.)

Changes in the value of production in EU countries within the analyzed years were most diverse. The biggest growth in production value was noted in Netherlands (36%). Also, the big growth was noted in the sector of advanced technology (over 10%), in Austria, Romania and Belgium. Unfavorable situation in this spite was in Greece, Hungary and Czech Republic – within these countries the reduction of the value of the production during analyzed years – accordingly of 14,3%, 9,9% and 7,0%. Presented tendencies of changes of the value of sold product of advanced technology, as well with the case of employment and number of enterprises did not cause relevant differences in the position in rankings which they got.

Previously presented partial indicators were the basis for the construction of synthetical measure of production potential of the sector of advanced technology of the countries from EU. Due to the incompetence of data, the indicator was measured only within these countries of EU in which it was able to analyze all of the variables. The clear leaders in this regard were countries such as: Germany, Great Britain (figure 1). High level of production potential of the sector of advanced technology was noted also in France.

**Figure 1.** Synthetical indicator of production potential of sector of advanced technologies within EU countries




**Source**: Own study based on tables 1-3

The average level of synthetical indicator was noted in Italy, Spain and Poland. It is worth to mention that some of the countries form central-eastern Europe took high places in this rank. It concerns mainly besides mentioned early Poland, but as well Czech Republic, Romania and Hungary. To sum up presented data, it needs to be stated that production potential of the EU countries results from their size and population. As an example, Luxembourg, Cyprus and Malta are not among countries with the high level of such indicators. According to that, both the number of subjects as well with the number of hired people and the value of production of the advanced technology sector is significantly lower than in comparison with the other EU countries.

## 4. Conclusion

Changes which are occurring in the present world indicates the growth of importance of the fields which are based mainly on the intensive usage of knowledge. Belongs to them

at most subjects belonging to the industries and services high-tech. Presented analysis points out that among EU countries the highest production potential of the sector of advanced technologies was noted in Germany, Great Britain and France. However, it should be emphasized that it is the result from (among many others) size of the countries and the number of hired people within them. Complementing the conducted research should be analysis the meaning (share) of the sector of advanced technologies within the national economies of the countries.

## References

Bogliacino, F., Piva, M., & Vivarelli, M. (2012). *R&D and employment: An application of the LSDVC estimator using European microdata*. Economics Letters, 116 (1), pp. 56-59.

European Commission (2013). *European Competitiveness Report 2013: Towards Knowledge Driven Reindustrialization,* Brussels: European Union.

Fagerberg, J. (2000). *Technological progress, structural change and productivity growth: a comparative study*. Structural Change and Economic Dynamics, 11, pp. 393–411.

Gomułka S. (2015). *Gospodarka światowa w XXI wieku: czy trendy wieku XX będą konty-nuowane?* „Studia Ekonomiczne", 4, pp.

Harbi S., Amamou M., Anderson AR. (2009). *Establishing High-Tech Industry*. The Tunisian ICT Experience. Technovation, 29, pp. 465-480.

Le T., Tang K. K. (2013). *Impacts of High-tech Research on High-tech Manufacturing Growth: Evidence from Supercomputer Data*. Hoa Sen.

Michael P. (2003). *Industrial Structure and Aggregate Growth*. Structural Change and Economic Dynamics. 14 (4), pp. 427-448.

Nordhaus, W. (2005). *The source of productivity rebound and the manufacturing employment puzzle*. NBER Working Paper, 11354, May 2005.

Srholec M. (2007). *High-Tech Exports from Developing Countries: A Symptom of Technology Spurts or Statistical Illusion?* Review of World Economics, 143(2), pp. 227-255.

Varum C. A., Cibrao, B., Morgado, A., Costa J. (2009). *R&D, Structural Change and Productivity: The Role of High and Medium-High Technology Industries*. Economia Aplicada, 13 (4), pp. 399-424.