OLSZTYN ECONOMIC JOURNAL
Abbrev.: Olszt. Econ. J., 2010, 5(1)

DOI 10.2478/v10021-010-0008-0

# KNOWLEDGE AND INNOVATION POTENTIAL: INTANGIBLE ECONOMIC RESOURCES IN THE NEW GLOBAL ECONOMY OF THE 21ST CENTURY*

***Adam P. Balcerzak***

Department of Microeconomics
University of Warmia and Mazury

K e y w o r d s: knowledge, innovation, knowledge-based economy, economic resources.

A b s t r a c t

The aim of the paper is to present the changes in importance of the intangible economic factors such as knowledge and level of innovation in relation to the currently observed institutional transformation of the economic system, which leads to development of the "new global knowledge-based economy". The article attempts at confronting the theoretical considerations with the empirical data based on the aggregated data for the OECD countries. The paper makes use of the statistical materials collated by the Eurostat and OECD. The analyzed data may suggest that widely treated innovation represents one of the most important elements determining the economic potential.

## WIEDZA I POTENCJAŁ INNOWACYJNY – NIEMATERIALNE ZASOBY EKONOMICZNE W NOWEJ GLOBALNEJ GOSPODARCE XXI WIEKU*

***Adam P. Balcerzak***

Katedra Mikroekonomii
Uniwersytet Warmińsko-Mazurski w Olsztynie

S ł o w a k l u c z o w e: wiedza, innowacje, gospodarka oparta na wiedzy, zasoby gospodarcze.

A b s t r a k t

Celem artykułu jest ukazanie zmian znaczenia takich niematerialnych czynników gospodarczych, jak wiedza i poziom innowacyjności, w związku z obecnie dostrzegalną transformacją instytu-

* The earlier version of this paper was presented during the V Scientific Conference of the series "Knowledge and innovation" on "Protection of knowledge and innovation" at the Jagiellonian University in Krakow on 19–20 January 2009.

** Wcześniejsza wersja niniejszego artykułu została zaprezentowana w trakcie V Konferencji Naukowej z serii „Wiedza i innowacje" pt. „Ochrona wiedzy i innowacji" na Uniwersytecie Jagiellońskim w Krakowie w dniach 19–20 stycznia 2009.

cjonalną systemu gospodarczego, która prowadzi do powstania „nowej globalnej gospodarki wiedzy". W artykule dokonano próby skonfrontowania rozważań o charakterze teoretycznym z danymi empirycznymi, bazując na danych zagregowanych dla krajów należących do OECD. W pracy tej wykorzystano materiał statystyczny gromadzony przez Eurostat oraz OECD. Przeanalizowane dane mogą sugerować, że szeroko traktowana innowacyjność stanowi jeden z najważniejszych elementów kształtujących potencjał gospodarczy.

## Introduction

The last decades were characterized by the increasing importance of knowledge related to the quality of human capital and knowledge embedded in the products, which increasingly often loose their tangible, material form and intangible values, new ideas and solutions frequently referred to as the intellectual input become their core. It can be concluded with no doubts that the 20th C. was the first stage in the fundamental institutional, technological and social transformation, which resulted in revaluation of the so-called tangible factors of production and intangible resources, including mainly the knowledge (BALCERZAK, ROGALSKA 2008, pp. 71–89). Peter Drucker defined that transformation as the process of shifting from the industrial society to the post-capitalistic society, in case of which knowledge and effective use of the information become the main factor in increasing productivity. As a consequence, they represent the main resource in the wealth generation process, the main source of the comparative advantages and international competitiveness of the country (DRUCKER 1999, pp. 22–60, 148–156)[1]. Establishment of the "new global knowledge-based economy" in case of which information goods, digital goods become the key determining factor of innovation, production, level and quality of consumption, and by the same of the macroeconomic effectiveness is the consequence of that process.

This paper aims at presenting the changes in importance of intangible economic factors such as knowledge and innovation level in relation to the synthetically presented above institutional transformation of the economic system. Additionally, the paper presents an attempt at confronting the theoretical considerations with empirical data based on the aggregated data for the OECD member countries and the data presenting the global perspective.

[1] Also from the microeconomic perspective it should be highlighted that ignoring the increasing importance of knowledge and innovation as the key economic resource represents a direct threat to the existence of both global corporations and small and medium enterprises (see: Popławski 2004, pp. 27-39).

## The nature of the new global knowledge-based economy

Assuming the Schumpeterian perspective, the new global knowledge-based economy should be treated as the global economy that is the effect of another wave of innovations, in this case the wave based on general use digital technologies (see: CARLSON 2004, pp. 245–264). Because of the fact that the diffusion of new general application technologies is the foundation for appearance of the new global knowledge-based economy, the process of its development encompasses a complex group of phenomena among which reorganization of economic entities, more effective and dynamic capital markets, increasing economic activity and dynamics of entrepreneurs, increasing variability of labor markets and irreversible globalization leading to continual and increasing national as well as international competition should be included (ATKINSON, CODURI 2002, pp. 2–4, LANDEFELD, FRAUMENI 2001, p. 23). It can be said, as a consequence that the new economy represents fundamental deviation from the national, corporate economy based on mass production of goods that dominated between the late 1940s and late 1970s. The new economy defined in that was is the global, knowledge and entrepreneurship based economy in which the extent to which the knowledge, technology and innovation are embedded in the products and services becomes the key success factor (ATKINSON, CORREA 2007, p. 3).

The new global knowledge-based economy is different from the "old" corporate economy existing from 1940s until 1970s in the same sense as the economy driven by technology changes in steel processing end electrification from the late 19th C. differed from the economy of the first half of the 19th C.[2] It is obvious that such evolution of the technological-economic system results in the institutional system transformation. This is reflected in and has significant implications for the economic role of the government, organization of business structures, labor market reality, legal system and finally the social and cultural changes (ATKINSON 2005, pp. 4–5). The most important differences between the so defined new global economy and the traditional industrial economy that dominated almost until the end of 1970s are presented in Table 1.

[2] Changes in production of cheap, high quality steel, development of machine industry and electrification process allowed development of the economy based on factory based production system able to make use of the effect of scale, which became an important determining factor in the process of oligopolyzation of the economy during the last decade of the 19th C. Those new economic structures of the late 19th C. differed diametrically from the structures dominated by small production companies focused on the local markets involved in free competition that dominated during from the beginning of the 19th C. (see: Mokyr 2001, pp. 9–14, Dawid 1990, pp. 355–361).

Table 1

Comparison of selected aspects of the new economy and industrial economy

| Item | Industrial economy | New global knowledge-based economy |
|---|---|---|
| Macroeconomic environment characteristic | | |
| Market | high stability | high variability |
| Scope of competition | national | global |
| Dominating organizational form | hierarchic, bureaucratic, linear | flat, network-based |
| Microeconomic perspective | | |
| Production organization | mass production | flexible production system |
| Growth factors | investments in tangible capital labor | high innovation knowledge |
| Dominating technology | mechanization | digitalization |
| Sources of competitive advantages | decrease of costs resulting from using the effects of scale | innovation, quality, organizational innovation (*just-in-time, time-to-market*) |
| Importance of research and innovation | low or moderate | high |
| Dominating relations with other entities | independence | high level of cooperation, alliances, collaboration |
| Selected labor market characteristics | | |
| Labor market policy goals | full employment | increasing the scope of labor use and increasing its productivity<br>higher real wages and incomes |
| Skills | limitation and specialization | wide skills, multiaspect training |
| Education | skills, high importance of formal education | continuous education |
| Labor market regulation and labor management | conflict management | cooperation management |
| Character of employment | high stability | higher risk level<br>larger importance of market opportunities |
| Government | | |
| Government-business relations | imposing of regulations | creating conditions for growth |
| Regulations | governance and high level of operational control | market tools, promotion of flexibility |

*Source:* own work based on: Atkinson, Correa (2007, pp. 3–12), Quah (2003, pp. 291–323), Black, Lynch (2003, pp. 546–565), Atkinson, Court (1998, p. 7), Hartman et al. (2001, p. XV).

## The role of knowledge in the 21st C. economy

The Moore's Law, which should not be interpreted only in the categories of the exponential progress rate in computing capacity of computer hardware[3], but which also refers to the exponential growth of the knowledge generated by the humanity is one of the most important driving forces in the process of fundamental transformation leading to establishment of the new economy defined in the preceding subsection. Analyzing the human history during the last forty thousand years we can conclude that while initially the growth of knowledge and innovation was vary slow, in the 19th C. more inventions were reated than during all the preceding millennia together. During the 20th C. each consecutive generation created knowledge exceeding in its scope the knowledge that represented the accrued result of activities of all the earlier generations (BOEHLKE 2005, pp. 30–31).

The process finds empirical confirmation in that currently the developed economies as well as the majority of dynamically developing counties forced to make-up for the developmental gap, are dependent to an increasing extent on production of goods and services the core of which is the knowledge and intellectual property embedded in them[4]. Such products have already long ago crossed the border of the narrowly treated high technology business. Currently, in case of the majority of sectors, even in the so-called traditional sectors of economic activities, the manufacturing processes are not only capital intensive but, first of all, they require a large input of knowledge embedded in high quality human resources and the resources that in their nature represent intellectual property (SZABO 2002, pp. 25–47). Because of the increasing interrelations between business entities we can talk about the global dimension of that trend. As a result of those structural transformations, according to the OECD computations already during the mid-1990s the so-called knowledge-based sectors and knowledge generating sectors were responsible for generating over 50% of the GDP in the highly developed countries (OECD 1996, p. 9).

Knowledge and intangible outlays have always been an immanent element of the production process. However, in the realities of the traditional industrial economy, when economic activities of business entities focused on production

[3] Gordon Moore, the founder of the Intel Company noticed that the economically optimal number of transistors in the integrated circuit doubles every 18–24 months while the price level remains constant. That change translates into the exponential increase of the computing capacity of contemporary computers, which coupled with constant prices means a fast pace of decrease in the real cost of computing capacity.

[4] It is worth to notice, for example, the changes leading to the increase in importance of the knowledge based economy that have recently taken place in China (more see: Burrows et al. pp. 73–76).

of material goods knowledge was used mainly for increasing the effectiveness of the production process in which the tangible product was the final effect. Currently, on the other hand, knowledge is used for production of goods based on knowledge or information goods (see: DRUCKER 1999, pp. 25–47)[5]. And production of such goods, as different from production of physical goods, is characterized by constant or decreasing effects of scale, it is linked to the possibility of increasing effects of scale, network effects that may in fundamental way influence the mode of operation of the contemporary economy[6].

That new reality does not have to translate necessarily into macroeconomic benefits equally available to all the economies[7]. The level of competences of market entities adequate to the needs of the new technological reality is the marginal condition for making use of the potential embedded in that reality. It may be treated in a wide way as all the social institutions necessary for adaptation of the new generation technology (ELIASSON et al., 2004, pp. 289–293). Among the major institutional components we can list here the adequately high quality of generally available human resources and the effective national innovation system (see: OKOŃ-HORODYŃSKA 2002, pp. 18–25; FREEMAN 2001, p. 116; OKOŃ-HORODYŃSKA 1998b).

The general efficiency of the education system is an important element influencing the quality of human resources in a given country. Despite numerous controversies concerning the quality of education in individual countries we can now talk about a very high general level of formal education and focus on improvement of knowledge during the professional life almost in all the highly developed economies. This is confirmed by the empirical data collected in Table 2 presenting the percentage share of people with minimum upper secondary education in the population (columns 1 and 2), the expected length of the learning process (column 3) and the data concerning training for professionally active people (column 4) during the years 1995–2005.

Countries, in which in 2005 the share of people with minimum upper secondary education in the entire population was lower than 60% represented a marginal position. Those were Spain, Italy, Malta and Portugal. In the age group of 20–24 years that threshold could be moved even to 70% and it was not met by Spain, Portugal, Malta and Iceland only. On the other hand, comparing the values of those indicators for the years 1995, 2000 and 2005 we can talk about the increasing trend even in the countries possessing very high results

---

[5] For example, Danny Quah lists, among others, widely understood knowledge, computer software, databases, products of the entertainment industry such as images, movies, computer games, various types of recipes, news, etc. as information goods of digital goods (Quah 2003, pp. 291–323).

[6] The issues related to microeconomic conditions of producing information products are widely analyzed by Hall Varian (see: 2001, p. 67; 2002, pp. 143–145).

[7] This was confirmed by the OECD empirical studies (see: 2004, 2002, 2001).

Table 2

Education and quality of human resources in selected countries during the years 1995–2005

| Country | 1 | | | 2 | | | 3 | | | 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2005 | 1995 | 2000 | 2005 | 1998 | 2000 | 2005 | 1995 | 2000 | 2005 |
| EU-27 | – | 64.4 | 69.3 | – | 76.6 | 77.4 | – | 16.7 | 17.6 | – | 7.1 | 9.7 |
| EU-15 | 55.5 | 61 | 66.2 | 69.2 | 73.7 | 74.6 | – | – | – | – | 8 | 11.2 |
| Euro zone countries | – | 60 | 64.4 | – | 72.7 | 73.5 | 16.5 | 16.6 | 17.2 | 4.5 | 5.4 | 8.1 |
| Belgium | 54.5 | 58.5 | 66.1 | 77.6 | 81.7 | 81.8 | – | 18.6 | 16.5 | 2.8 | 6.2 | 8.3 |
| Bulgaria | – | 67.5 | 72.5 | – | 75.2 | 76.5 | 14.1 | 14.2 | 15.5 | – | – | 1.3 |
| Czech Republic | – | 86.1 | 89.9 | – | 91.2 | 91.2 | 15.1 | 15.6 | 17.1 | – | – | 5.6 |
| Denmark | 79.5 | 78.5 | 81 | 89.3 | 72.0 | 77.1 | 17.4 | 17.8 | 19.0 | 16.8 | 19.4 | 27.4 |
| Germany | 81.2 | 81.3 | 83.1 | 79.4 | 74.7 | 71.5 | 16.8 | 17.2 | 17.4 | – | 5.2 | 7.7 |
| Estonia | – | 86.1 | 89.1 | – | 79.0 | 82.6 | 15.4 | 16.8 | 18.5 | – | 6.5 | 5.9 |
| Ireland | 47.3 | 57.6 | 65.2 | 73.8 | 82.6 | 85.8 | 16.0 | 16.3 | 17.4 | 4.3 | – | 7.4 |
| Greece | 42.6 | 51.6 | 60 | 73.8 | 79.2 | 84.1 | 14.6 | 15.0 | 17.7 | 0.9 | 1 | 1.9 |
| Spain | 29.5 | 38.6 | 48.5 | 59.0 | 66.0 | 61.8 | 17.0 | 17.0 | 17.2 | 4.3 | 4.1 | 10.5 |
| France | 58.8 | 62.2 | 66.4 | 78.6 | 81.6 | 82.6 | 16.7 | 16.6 | 16.7 | 2.9 | 2.8 | 7 |
| Italy | 36.3 | 45.2 | 50.4 | 58.9 | 69.4 | 73.6 | 15.9 | 16.1 | 17.0 | 3.8 | 4.8 | 5.8 |
| Cyprus | – | 61.5 | 66.6 | – | 79.0 | 80.4 | – | 13.0 | 14.5 | – | 3.1 | 5.9 |
| Latvia | – | 83.2 | 84.5 | – | 76.5 | 79.9 | 14.3 | 15.5 | 17.9 | – | – | 7.9 |
| Lithuania | – | 84.2 | 87.6 | – | 78.9 i | 87.8 | 14.4 | 15.8 | 18.0 | – | 2.8 | 6 |
| Luxembourg | 42.9 | 60.9 | 65.9 | 51.9 | 77.5 | 71.1 | – | 14.3 | 13.9 | 2.9 | 4.8 | 8.5 |
| Hungary | – | 69.4 | 76.4 | – | 83.5 | 83.4 | 15.4 | 16.1 | 17.7 | – | 2.9 | 3.9 |
| Malta | – | 18.1 | 25.3 | – | 40.9 | 53.7 | – | 14.4 | 15.3 | – | 4.5 | 5.3 |
| The Netherlands | 63.1[a] | 66.1 | 71.8 | 67.6[a] | 71.9 | 75.6 | 17.2 | 17.2 | 17.5 | 13.1 | 15.5 | 15.9 |
| Austria | 68.9 | 76.2 | 80.6 | 79.2 | 85.1 | 85.9 | 16.0 | 15.5 | 16.3 | 7.7 | 8.3 | 12.9 |
| Poland | – | 79.8 | 84.8 | – | 88.8 | 91.1 | 15.6 | 16.4 | 17.8 | – | – | 4.9 |
| Portugal | 21.9 | 19.4 | 26.5 | 45.1 | 43.2 | 49.0 | 16.6 | 16.9 | 16.9 | 3.3 | 3.4 | 4.1 |
| Rumania | – | 69.3 | 73.1 | – | 76.1 | 76.0 | 13.6 | 14.0 | 15.3 | – | 0.9 | 1.6 |
| Slovenia | 69.5[a] | 75.3 | 80.3 | 84.4[a] | 88.0 | 90.5 | 15.1 | 16.7 | 17.8 | – | – | 15.3 |
| Slovakia | – | 83.8 | 87.9 | – | 94.8 | 91.8 | 17.4 | 17.2 | 15.9 | – | – | 4.6 |
| Finland | 66.8 | 73.2 | 78.8 | 82.4 | 87.7 | 83.4 | 17.8 | 18.6 | 20.2 | 16.3[a] | 17.5 | 22.5 |
| Sweden | 74.1 | 77.2 | 83.6 | 88.1 | 85.2 | 87.5 | 19.1 | 19.9 | 20.0 | 26.5[a] | 21.6 | 32.1 |
| United Kingdom | 52.8 | 64.2 | 71.7 | 64.0 | 76.6 | 78.2 | 17.1 | 18.9 | 20.5 | – | 20.5 | 27.5 |
| Iceland | – | 55.8 | 62.9 | – | 46.1 | 50.8 | 17.7 | 17.9 | 19.8 | 14.1 | 23.5 | 25.7 |
| Norway | – | 85.4 | 88.2 | 90.1a | 95.0 | 96.2 | 17.6 | 17.8 | 18.2 | – | 13.3 | 17.8 |
| Switzerland | – | 81.8 | 86.9 | 83.7a | 77.7 | 78.3 | – | – | 16.8 | – | 34.7 | 26.9 |

Where:
(–) no data available
[a] – data for the year 1996
1. Share of people aged 25–64 years possessing at least upper secondary education
2. Share of people aged 20–24 years possessing at least upper secondary education
3. Expected length of education during the lifetime
4. Life-long learning of working people aged 25–65, estimated as the share of people taking active part in training programs and receiving formal education during the 4 weeks preceding the examination of the entire population

*Source*: Europe in figures – Eurostat yearbook 2006–2007, Eurostat, Luxembourg 2006, http://epp.eurostat.ec.europa.eu/ (17.12.2007).

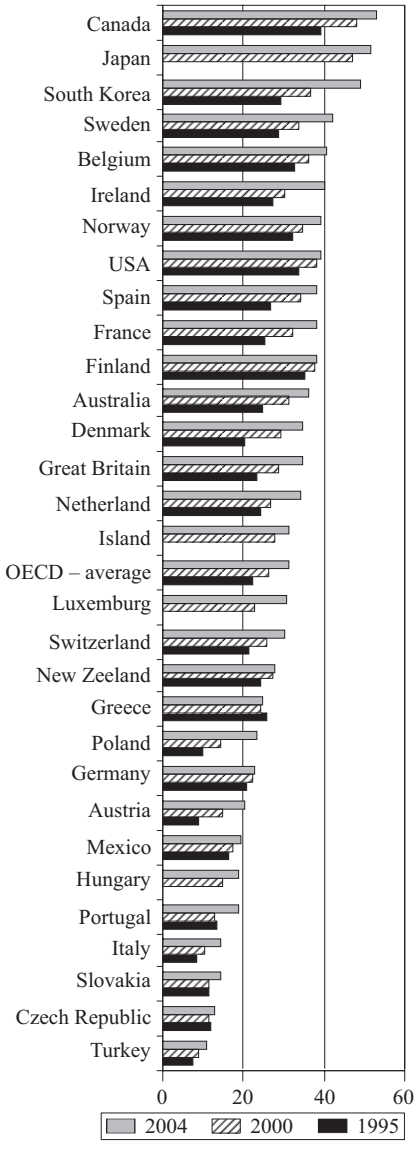


Fig. 1. Share of people with tertiary attainment in the population aged 25–34 years in the OECD countries during the years 1995–2004
*Source:* OECD [2007c, pp. 179–180] and http://puck.sourceoecd.org/vl=6735976/cl=25/nw=1/rpsv/factbook/ (18.01.2008)

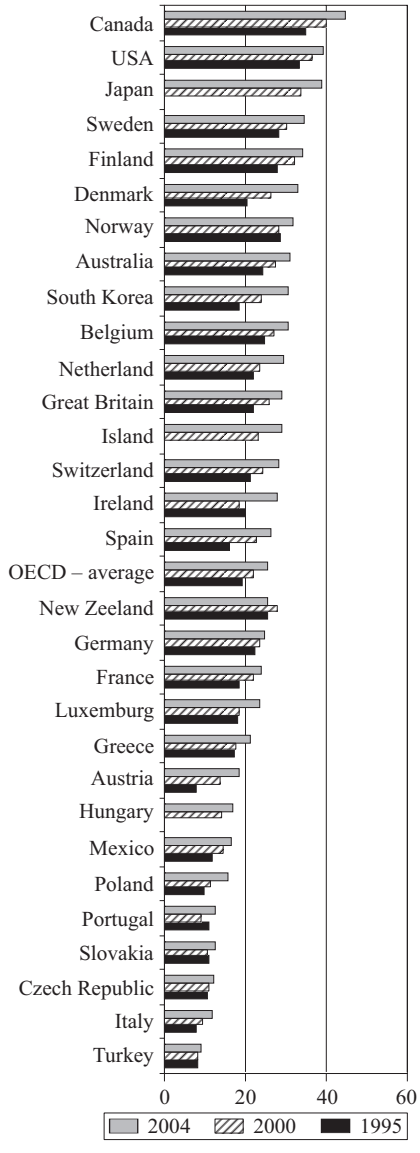


Fig. 2. Share of people with tertiary attainment in the population aged 25–64 years in the OECD countries during the years 1995–2004
*Source:* OECD [2007c, pp. 179–180] and http://puck.sourceoecd.org/vl=6735976/cl=25/nw=1/rpsv/factbook/ (18.01.2008)

already in 1995 as the Scandinavian countries or, e.g. the Baltic States. This indicates the educational convergence in the level of formal education in case of the economically developed countries. This is also confirmed by column 3 presenting the extending expected duration of education during the lifetime almost in all the countries.

The high rate of depreciation of the knowledge acquired during formal education is one of the major challenges that are faced by the educational systems in individual countries[8]. As a consequence, maintaining high quality of the human resources requires development of the ability of life-long education. Despite the high level of convergence in formal education (columns 1 and 2) we can talk about significant differences in the availability of training during the entire professional life in case of the EU countries, which is presented in column 4. In 2005, in the European Union (EU-27), 9,7% of professionally active people participated in training and education while in the Scandinavian countries and the United Kingdom or Switzerland that percentage was almost 30%. Comparing, however, the changes during the years 1995–2005 we can talk without exception about the quickly increasing awareness of the importance of life-long education process. This translates into high dynamics of educational-training services consumption.

Figures 1 and 2 present the share of people with tertiary attainment in the population aged 25–34 years in the OECD countries during the years 1995–2004 and the same indicator for the population aged 25–64 years. The presented data indicate that in all the OECD countries a significant increase in the share of people with tertiary attainment was recorded. In 2004, for the population aged 25–64 years, in case of almost a half of the countries the share of the population with tertiary attainment ranged 23–33%, while in Finland, Sweden, Japan, the USA and Canada that share was: 34%; 34.5%; 37.4%; 39.1% and 44.6% respectively. In the population aged 25–34 years those values were even higher while the average share of the people with tertiary attainment for OECD as a whole increased from 22.5% to 31%.

It must be concluded that Table 2 and Figures 1 and 2 indicate an increasing importance of knowledge as a global phenomenon.

## Relations between: investments in research and development – technology – economy

Currently there is a consensus among the economists according to which innovation encompassing introduction of new products, new processes and

[8] The challenges that the national educational systems are facing in view of the global economic transformation are analyzed comprehensively by Ewa Okoń-Horodyńska (see: 2003, pp. 90–99; 1999, pp. 83–100).

improvement of the existing organizational solutions as well as technological changes concerning diffusion of new technological solutions are the key engines of economic development. However the mainstream economy is all the time far from development of the theory that would solve the issues of the complex influence of innovation and technological change on the process of economic development (for more see GODIN 2004, p. 687)[9]. Moreover, all the time we can talk about significant difficulties related to empirical identification of the influence of innovation and technological progress on economic growth. This is relatively simple in case of microeconomic studies limited to a selected economic sector or a defined group of enterprises (see: BRESNAHAN et al. 2002, pp. 339-376). However in case of studies of macroeconomic character, and even more in case of international comparisons, this is highly difficult[10].

Economists conducting studies on the national innovation systems highlight the position that attempting at developing a theory explaining the influence of innovation on economic growth rate one cannot limit the activities to narrowly understood influence of R&D institutions, and the more so the quantitative approach only, but a wide socio-economic context of those activities should also be considered[11]. However, despite the above objections, the analysis of contemporary literature of mainstream economy in the area, the endogenous growth theory and evolutional economy theory allows indicating the relations and mechanisms of links and influences between outputs on research and development, innovations and technological changes on one hand and the economic growth rate on the other. That is presented in Figure 3. Those mechanisms already have a relatively satisfying support in empirical analyses conducted, among others, by the OECD (2004, 2001, 2000).

---

[9] It should be pointed out here, however, that the important achievements in that area are those by the economists developing the models of endogenous economic growth initiated by Paul Romer (1986, pp. 1002–10037), which should be treated here as the modern formalized theory based in the Schumpeterian tradition (see: Nelson 1997, pp. 29–58).

[10] The traditional theoretical problems, such as lack of leverage of microeconomic benefits of technological changes to macroeconomic benefits when those changes are the source of redistribution of the existing benefits only and do not create new ones, are supplemented by the problems with measuring the macroeconomic influence of innovation and the problems of ineffectiveness of the international statistical systems. The issue of effectiveness of measuring the influence of innovation on macroeconomic effects in itself is the source of immense controversies that have appeared during the two last decades. Currently the consensus was reached according to which the traditional statistical systems that were unable to identify the improvement in quality of goods and services at constant price level understated significantly the statistical influence of innovation on the gross domestic product. This applied in particular to the sectors characterized by high technological change intensity and innovation such as teleinformatics. Moreover, the time delays in obtaining macroeconomic benefits that are common in case of investments in the state-of-the-art technological solutions should also be remembered. Those delays result from the necessity of introducing complementary technological and organizational innovations and the necessity of securing the time necessary to obtain the sufficient level of diffusion of the new solutions in the economy.

[11] Critique of the approach typical for mainstream economy from the perspective of institutional economists can be found in the work by Ewa Okoń-Horodyńska (see: 1998a, pp. 41–45).

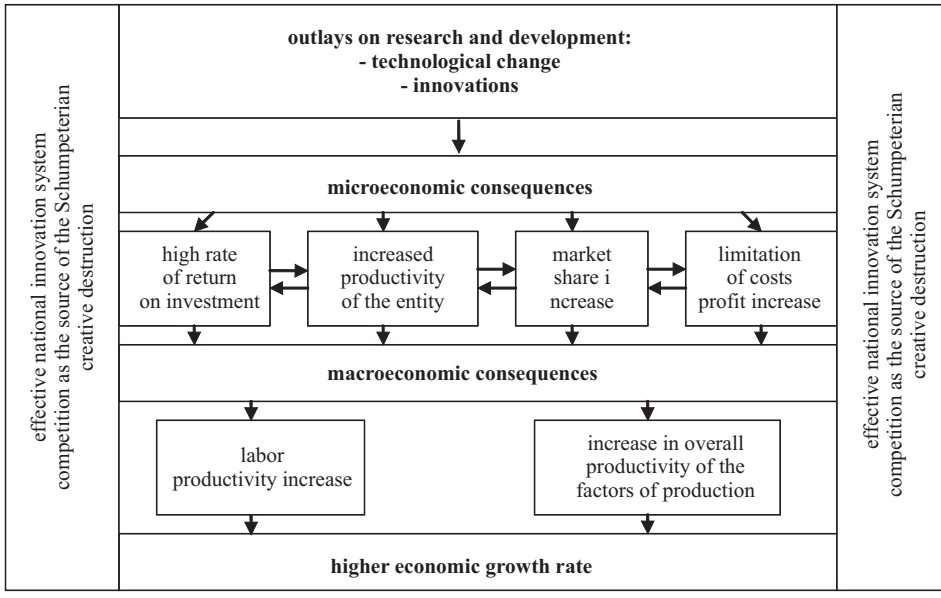


Fig. 3. Relations between outlays on research and development as the factor supporting innovation and stimulating the process of technological changes and economic growth
*Source*: own work based on: GRIFFITH et al. (2004, pp. 883–895), RAO et al. (2001, pp. 11–12), CAMERON (1998), FAGERBERG (1994, pp. 1147–1175).

Assuming the microeconomic perspective it may be concluded that economic entities decide fro investments in research and development, implementation of innovations and conducting technological changes aiming at increasing their productivity and limiting the operational costs while expecting a high rate of return on investment. This translates into the ability of the entity to increase its market share. All those elements are of course strongly correlated. However, as the innovational activity of a micro-subject bears a significant risk those potential microeconomic benefits are insufficient to stimulate innovation activities characterized by the same intensity in all sectors of the economy or in all the countries. This means that they must clearly translate into macroeconomic benefits (see: *Reaching*... 2002, *US Productivity*... 2001). Empirical studies prove that the major factors forcing entities to undertake activities of that type include effectiveness of the institutional system that should, first of all, support high competitive pressure and high flexibility of the economy (BAILY, LAWRENCE 2001, pp. 308–313). Where those conditions are satisfied, entities undertaking the innovative effort usually obtain higher than average productivity in their sectors and increase their market share, which, in the process of the dynamic market game forces the other, less active enterprises to

undertake the same innovative effort. On the other hand, market players that do not involve themselves in the innovative activities are eliminated from the market in the Schumpeterian process of creative destruction while their place is taken by the entities that are more active.

Efficient operation of that mechanism at the microeconomic level accelerates the innovation diffusion processes and supports obtaining positive external effects related to it. At the macroeconomic level this is reflected in increasing the general productivity of production factors and labor productivity. This is a condition for a higher economic growth rate (BAILY 2001, pp. 223–226). Econometric studies confirm statistical significance of the outlays on research and development and the product increase, which is the consequence of the direct influence of the R&D outlays on innovation of the economy and indirect influence on the effectiveness of technology transfer, which in turn translates into increasing the general productivity of production factors (see: GRIFFITH et al. 2004, pp. 883–895).

Although the aggregated rate of outlays on research and development for the OECD countries increased only from the level of 1,92% in 1981 to 2,26% in 2004 (OECD 2007, p. 147), more detailed empirical data provide important arguments in support of the thesis on the increasing importance of innovation and research and development outlays in creating conditions for economic potential increase. Table 3 presents the data concerning research and development outlays (column 1) and the share of the industrial sector in financing those outlays (column 2) for the major OECD countries during the years 1985-2005. The data presented in column 1 indicate a relative stability in the share of R&D outlays in the GDP, with the exception of Scandinavian countries, which during the analyzed period doubled their investments in that field to over 3%[12]. The data presented in column 2 indicate the increasing role of business in many countries in financing the research and development outlays. The situation was recorded in case of Denmark, Germany, Ireland, France, Slovenia, Finland, Sweden, Turkey, Iceland, the USA and Japan. For the so-called old European Union that ratio increased from 53,1% in 1995 to 54,8% in 2005.

[12] It is worth reminding that according to the international assessment of use of the potential of changes in the global economy by the European countries during the 1990s, only Scandinavian countries and Ireland scored positively in that area while the largest economies of Europe were unable to make use of the opportunities offered by the "new economy". Of course the R D outlays are just one of the elements of the national innovation system as a consequence of which this does not provide the straight empirical evidence confirming them as the condition for use of the potential of the "new economy".

Table 3
Outlays on research and development in selected OECD countries during the years 1985–2005

| Country\year | 1 | | | | | 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1985 | 1990 | 1995 | 2000 | 2005 | 1985 | 1990 | 1995 | 2000 | 2005 |
| EU-27 | – | – | – | 1.86 | 1.84 | – | – | 53 | 56.3 | 54.5 |
| EU-15 | – | – | – | 1.92 | 1.91 | – | – | 53.1 | 56.6 | 54.8 |
| Belgium | 1.62 | 1.62[b] | 1.67 | 1.97 | 1.84 | 66.5 | 64.8[b] | 67.1 | 62.4 | – |
| Denmark | 1.19 | 1.55 | 1.82 | 2.24 | 2.45 | 48.9 | 49.3 | 45.2 | 59[c] | – |
| Germany | – | 2.46[b] | 2.19 | 2.45 | 2.48 | 61.1 | 63.5 | 60 | 66 | 66.8[d] |
| Ireland | – | 0.83 | 1.26 | 1.12 | 1.26 | 45.7 | 59.1 | 67.4 | 66.7 | 58.7 |
| Greece | 0.27[a] | 0.36[b] | 0.43 | 0.6[c] | 0.58 | – | 21.8[b] | 25.5 | 24.2[c] | – |
| Spain | 0.53 | 0.82 | 0.79 | 0.91 | 1.12 | 47.2 | 47.4 | 44.5 | 49.7 | – |
| France | 2.17 | 2.32 | 2.29 | 2.15 | 2.13 | 41.4 | 43.5 | 48.3 | 52.5 | 51.7[d] |
| Italy | 1.10 | 1.25 | 0.97 | 1.05 | 1.10 | 44.6 | 43.7 | 41.7 | – | – |
| The Netherlands | 1.99 | 2.07 | 1.97 | 1.82 | 1.73 | 51.7 | 48.1 | 46 | 51.4 | – |
| Austria | 1.21 | 1.36 | 1.54 | 1.91 | 2.41 | 49.1 | 52.1 | 45.7 | 41.8 | 45.7 |
| Portugal | – | 0.51 | 0.54 | 0.76 | 0.81 | 28.3 | 27 | 19.5 | 27 | – |
| Slovenia | – | – | 1.57 | 1.41 | 1.46 | – | – | 45.9 | 53.3 | 65.2 |
| Finland | 1.54 | 1.84 | 2.26 | 3.34 | 3.48 | – | 56.3[b] | 59.5 | 70.2 | 69.3[d] |
| Sweden | 2.78 | 2.72[b] | 3.32 | 3.6[c] | 3.89 | 60.9 | 61.9[b] | 65.5 | 67.8[c] | – |
| United Kingdom | 2.24 | 2.14 | 1.94 | 1.85 | 1.76 | 45.9 | 49.6 | 48.2 | 48.3 | 44.2[d] |
| Turkey | – | 0.32 | 0.38 | – | – | – | 27.4 | 30.8 | 42.9 | – |
| Iceland | 0.73 | 0.97 | 1.53 | 2.29[c] | 2.78 | 24.1 | 23.9 | 34.6 | 43.4[c] | – |
| Norway | 1.47 | 1.62[b] | 1.69 | 1.63[c] | 1.52 | 51.6 | 44.5[b] | 49.9 | 49.5[c] | – |
| USA | 2.73 | 2.63 | 2.49 | 2.74[e] | 2.68[de] | 50.3 | 54.6 | 60.2 | 68.6 | 61.4[d] |
| Japan | 2.75 | 2.97 | 2.92 | 2.99[e] | 3.13[de] | 68.9 | 73.1 | 67.1 | 72.4 | 74.5[d] |

Where:
1. Share of R&D outlays in the GDP;
2. Percent of R&D outlays financed by the industry;
[a] – data for 1986; [b] – data for 1991; [c] – data for 1999; [d] – data for 2004; [e] – source: OECD [2007 c, p. 147]; (–) – no data available.
*Source*: Eurostat, *Europe in Figures – Eurostat Yearbook 2006–2007*, http://epp.eurostat.ec.europa.eu/ (17.12.2007).

Increase in the level of R&D activities financing by business means stimulation of investments that are well focused on satisfying market requirements. This translates into a high added value of investments of that type. This is confirmed by a high correlation coefficient equal to 0,94 between R&D outlays financed by the industry and the number of new patents awarded in the OECD countries during the years 1996-2002. This has been presented in Figure 4.

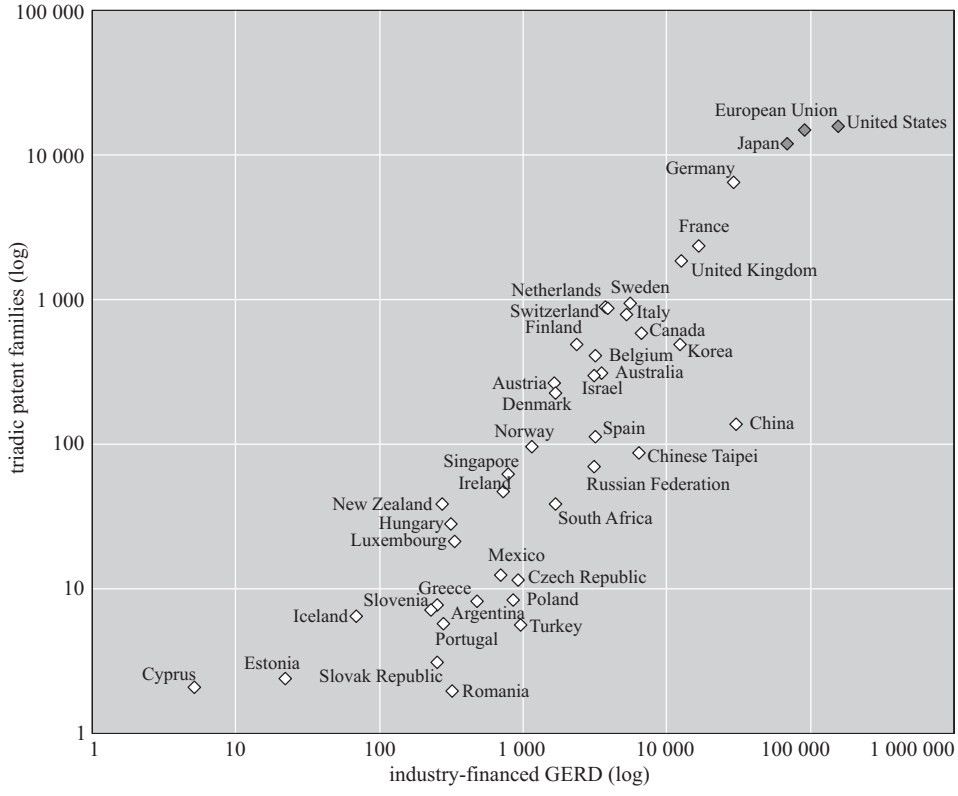


Fig. 4. Patents* and R&D outlays financed by the industry** during the years 1996–2002 in selected countries

* Patents in EPO, USPTO and JPO. Data for the years 2000 2002 represented a projection,

** R&D outlays financed by the industry in millions 2000 USD based on the purchasing power parity delayed by one year.

*Source*: OECD, *Patent and R&D Databases*, December 2005.

Increase in the R&D outlays financed by industry, however, when accompanied by stagnation or even a decrease in outlays of that type by the government, may mean limitation of financing for research in the area of general application technologies. Such technologies, because of the costs and risk level, are much less frequently financed by the private sector while general application technologies are the source of the basic benefits leading to the increase in general productivity of production factors. That problem undoubtedly is one of the major challenges for individual countries. This applies in particular to the countries that are leaders in the global technology race and that cannot benefit from the so-called convergence rent. The increase of business interest in R&D type activities in itself, however, indicates an

increasing role of innovation in creating the microeconomic success of business entities, which, in case of maintaining adequate institutional conditions translates into macroeconomic benefits.

Comparing the volumes of R&D outlays in countries with different sizes of economic potential it should also be remembered that investments of that type may also play a different role in stimulating economic growth in small and large economies. A lot indicates that in case of the later ones outlays on R&D contribute mainly to increasing the innovation level of the economy. In case of the small economies the domestic outlays on research and development represent a very important factor increasing the capacity of the economy for transfer and diffusion of foreign technologies, which also is one of the most important conditions for closing the developmental gaps[13].

Strong arguments for the thesis on the increasing role of innovation in creating welfare are provided by empirical data on the number of patents awarded in the OECD countries. The information contained in the data concerning the numbers of patents awarded is particularly important as it represents the main synthetic measure of effectiveness of the national innovation system in a given country. Figure 5 presents the number of patents awarded in the OECD countries during the years 1985–2002. Figure 6 represents the same measure for the United States, Japan and Germany. The data shows that during the analyzed period the number of patents awarded increased fourfold.

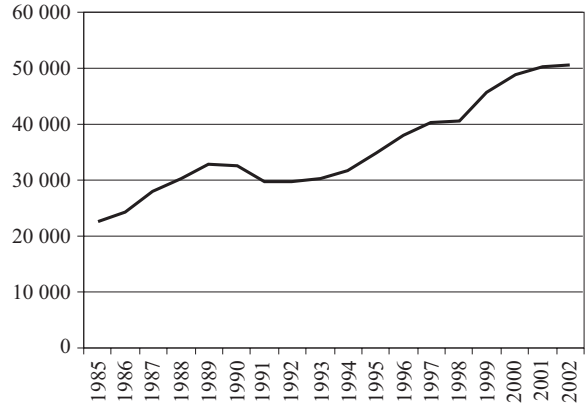


Fig. 5. Number of patents awarded in OECD countries during the years 1985–2002
*Source*: own work based on: OECD, *OECD Compendium of Patent Statistics*, 2005 http://www.oecd.org/topicstatsportal/0,3398,en_2825_497105_1_1_1_1_1,00.html#500742 (15.12.2007).

[13] Those issues are analyzed in detail by Rachel Griffith, Stephen Redding and John Van Reenen on the basis of the analysis of the influence of R D outlays on innovation and technology transfer rate fro twelve OECD countries (see: Griffith et al. 2004, pp. 883–895).

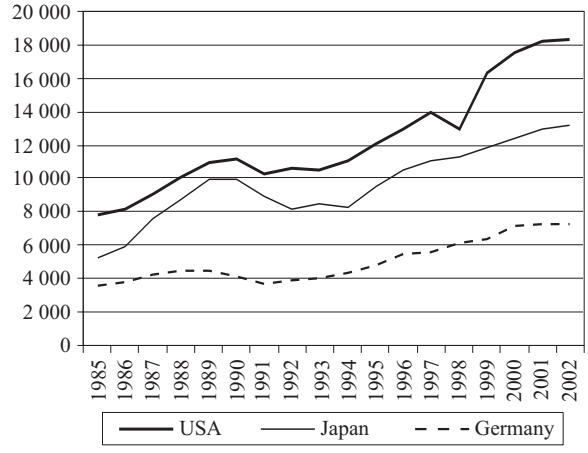


Fig. 6. Number of patents awarded in the USA, Japan and Germany during the years 1985–2002
*Source*: own work based on: OECD, *OECD Compendium of Patent Statistics*, 2005 http://www.oecd.org/topicstatsportal/0,3398,en_2825_497105_1_1_1_1_1,00.html#500742 (15.12.2007).

In addition to the data presenting the changes of the phenomenon studied in absolute values it is also worth to analyze the relative indicators such as, e.g. the relation of the number of patents awarded to the GDP or the number of patents awarded per million residents. Figure 7 presents the first of those indicators for the years 1991 and 2002. Figure 8 concerns the later of the two earlier mentioned indicators. Both figures confirm a strong increase in the relation of patents awarded to the GDP and an increase in the number of patents ac compared to the population of the given country.

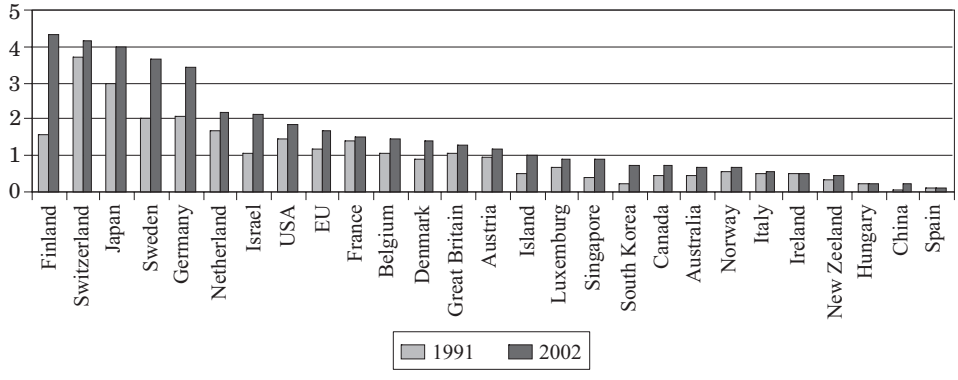


Fig. 7. Relations of the number of patents awarded to the GDP in selected countries in 1991 and 2002*
* GDP, billion 2000 USD using the purchasing power parity, EU covers the EU – 15.
*Source*: OECD, *OECD Compendium of Patent Statistics*, 2005 http://www.oecd.org/topicstatsportal/0,3398,en_2825_497105_1_1_1_1_1,00.html#500742 (15.12.2007).

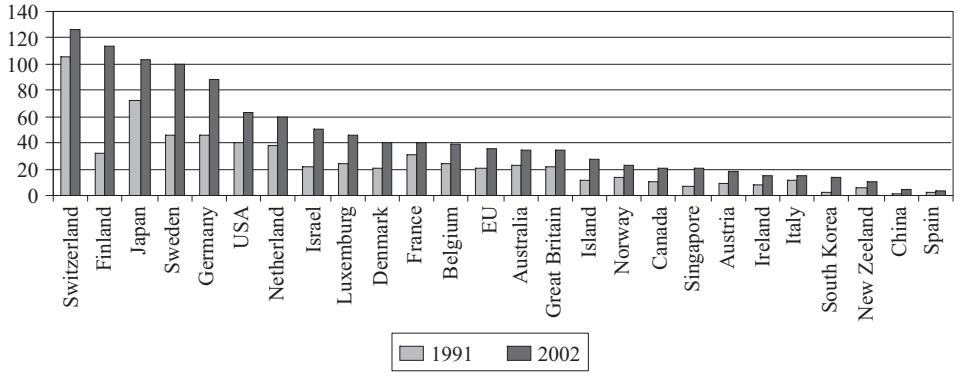


Fig. 8. Number of patents awarded per million residents in selected countries in 1991 and 2002
*Source*: OECD, *OECD Compendium of Patent Statistics*, 2005
http://www.oecd.org/topicstatsportal/0,3398,en_2825_497105_1_1_1_1_1,00.html#500742 (15.12.2007).

That growth is frequently explained by changes in legal regulations concerning protection of the intellectual property rights. In particular, this applies to the United States where as of mid-1970s regulations related to patent protection have been implemented covering innovations in the teleinformation sector. Robert Hunt, however, indicates that not only those changes were responsible for the increase in the number of registered innovations in the high technologies sector where the dynamics of patents awarded was the highest. He presents a formal model indicating that the earlier mentioned modification in protection of the intellectual property rights could lead to decreasing the propensity for investing in research and development in the sector of the highest technologies, which, however, did not take place as a result of coincidence of other factors (HUNT 1999a, pp. 4–9, 1999b, pp. 18–21)[13]. In case of the majority of the European Union countries we cannot point at such modifications in the institutional system although the increase in the number of patents awarded relative to the GDP was recorded in those countries. Additionally, in Finland, Sweden, Germany, The Netherlands and countries outside the European Union such as Japan, Switzerland and Israel that increase was even higher than in the United States. This indicates to a large extent the universality of that phenomenon. As the consequence the data indicates the increasing role of R&D and innovation investments in functioning of the countries in the reality of the new global economy.

[14] This proves how important and at the same time sensitive issue in the realities of the "new economy" the issue of regulation and modification of the intellectual property rights protection system is (more see: Balcerzak, Rogalska 2008, pp. 71–88).

## Conclusions

The above presented arguments confirm that widely treated innovation and intangible economic resources such as the knowledge are currently among the most important elements influencing functioning of contemporary highly developed economies. That comment applies to both micro- and macroeconomic perspective. From the perspective of an individual enterprise or sector the entities must implement process, product and organizational innovations to be able to satisfy the increasing requirements of the business partners and clients and at the same time retain or increase the distance from their competitors that frequently operate in global markets. Implementation of such innovations requires human resources with appropriate knowledge available.

From the macroeconomic perspective the studies confirm that countries implementing the economic policy compatible with those fundamental processes and able to modify their institutional systems efficiently and at sufficiently rapid pace were able to make better use of their potential created by that economic-technological transformation process. On the other hand, the history of the earlier technological-economic "revolutions" proves that ignoring fundamental changes and absence of adequate actions by the state not only makes use of the potential stemming from the new reality impossible but also results in the erosion of strengths of the given economy.

Translated by JERZY GOZDEK

Accepted for print 4.12.2009

## References

ATKINSON R.D., CORREA D.K. 2007. *The 2007 State New Economy Index. Benchmarking Economic Transformation in the States.* Kauffman Foundation, The Information Technology and Innovation Foundation, February.

ATKINSON R.D. 2005. *The Post and Future of America's Economy. Long Waves of Innovation that Power Cycles of Growth.* Edward Elgar, Washington.

ATKINSON R.D., CODURI R. 2002. *The State New Economy Index. Benchmarking Economic Transformation in the Sates.* Progressive Policy Institute Technology, and New Economy Project, July.

ATKINSON R.D., COURT R.H. 1998. *The New Economy Index: Understanding America's Economic Transformation.* Progressive Policy Institute Technology, Innovation, and New Economy Project, November.

BAILY M.N., LAWRENCE R.Z. 2001. *Do We Have a New E-Conomy?* American Economic Review, 91(2).

BAILY M.N. 2001. *Macroeconomic Implications of the New Economy.* In: *Economic Policy for the Information Economy.* A Symposium Sponsored by The Federal Reserve of Kansas City, Jackson Hole, 30 August – 1 September.

BALCERZAK A.P., ROGALSKA E. 2008. *Ochrona praw własności intelektualnej w warunkach nowej gospodarki.* In: *Własność i kontrola w teorii i praktyce.* Tom II. Eds. B. POLSZAKIEWICZ, J. BOEHLKE. Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń.

BLACK S.E., LYNCH L.M. 2003. *The New Economy and the Organization o Work*. In: *New Economy Handbook*. Ed. D.C. James. Elsevier Academic Press, San Diego.
BOEHLKE J. 2005. *Prawo Moore'a, gospodarka oparta na wiedzy, globalizacja – wyzwania dla ekonomicznej teorii firmy*. In: *Wiedza jako czynnik międzynarodowej konkurencyjności w gospodarce*. Eds. B. GODZISZEWSKI, M. HAFFER, M.J. STANKIEWICZ. TNOiK „Dom Organizatora", Toruń.
BRESNAHAN T.F., BRYNJOLFSSON E., HITT L.M. 2002. *Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level evidence*. Quarterly Journal of Economics, 1.
BURROWS C.R., DRUMMOND D.L., MORTINSONS M.G. 2005. *Knowledge Management in China*. Communication of the ACM, 48(4).
CAMERON G. 1998. *Innovation and Growth: A Survey of the Empirical Evidence*. Nuffield College, Oxford, OXI INF, UK.
CARLOSN BO. 2004. *The Digital Economy: What is New and What is Not?*. Structural Change and Economic Dynamics, 15(3).
DAVID P. 1990. *The Dynamo and the Computer An Historical Perspective on the Modern Productivity Paradox*. American Economic Review, 80(2).
DRUCKER P.F. 1999. *Społeczeństwo pokapitalistyczne*. Wydawnictwo Naukowe PWN, Warszawa.
ELIASSON G., JOHANSSON D., TAYMA E. 2004. *Simulating the New Economy*. Structural Change and Economic Dynamics, 15(3).
*Europe in figures – Eurostat yearbook 2006–2007*. 2006. Eurostat, Luksemburg, http://epp.eurostat.ec.europa.eu/ (17.12.2007)
FAGERBERG J. 1994. *Technology and International Differences in Growth Rates*. Journal of Economic Literature, 32(3).
FREEMAN C. 2001. *A Hard Landing for the "New Economy"? Information Technology and the United States National System of Innovation*. Structural Change and Dynamics, 12(2).
GODIN B. 2004. *The New Economy: What the Concept Owes to the OECD*. Research Policy, 33(5).
GRIFFITH R., REDDING S., REENEN J. VAN. 2004. *Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries*. Review of Economics and Statistics, 86(4).
HARTMAN A., SIFONIS J., KADOR J. 2001. *E-biznes. Strategie sukcesu w gospodarce internetowej*. Liber, Warszawa.
HUNT R.M. 1999a. *Nonobviousness and the Incentive to Innovate: an Economic Analysis of Intellectual Property Reform*. Federal Reserve Bank of Philadelphia, Working Paper 99–3, March.
HUNT R.M. 1999b. *Patent Reform: A Mixed Blessing for the U.S. Economy?* Federal Reserve Bank of Philadelphia Business Review, November/December.
LANDEFELD J.S., FRAUMENI B.M. 2001. *Measuring the New Economy*. Survey of Current Business, March.
*Measuring the Information Economy*. 2002. OECD, Paris.
MOKYR J. 2001. *Economic History and the New Economy*. Business Economics, 36(2).
NELSON R. 1997. *How New Is New Growth Theory?* Challenge, 40(5).
*OECD Compendium of Patent Statistics, 2005*. OECD.
http://www.oecd.org/topicstatsportal/0,3398,en_2825_497105_1_1_1_1_1,00.html#500742 (15.12.2007)
OKOŃ-HORODYŃSKA E. 2003. *Edukacja a umiejętność funkcjonowania w układzie globalnym*. In: *Problemy i kontrowersje wokół globalizacji*. Ed. E. OKOŃ-HORODYŃSKA. Wydawnictwo Akademii Ekonomicznej im. Karola Adamieckiego w Katowicach, Katowice.
OKOŃ-HORODYŃSKA E. 2002. *A Concept of The National Innovation System (NIS)*. In: *Innovation in Transition. The Case of Poland*. Ed. A.H. JASIŃSKI. Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego, Warsaw.
OKOŃ-HORODYŃSKA E. 1999. *Kształcenie a umiejętność funkcjonowania w układzie globalnym*. In: *Wyzwania procesu globalizacji wobec człowieka*. Ed. E. OKOŃ-HORODYŃSKA. Wydawnictwo Akademii Ekonomicznej im. Karola Adamieckiego w Katowicach, Katowice.
OKOŃ-HORODYŃSKA E. 1998a. *Narodowy system innowacji w Polsce*. Akademia Ekonomiczna im. Karola Adamieckiego, Katowice.
OKOŃ-HORODYŃSKA E. 1998b. *Globalizacja technologii i powiązanych z nią badań oraz wiedzy*. In: *Instytucjonalizacja aktywności ekonomicznej w gospodarce światowej w układach narodowym, regionalnym i globalnym*. Ed. E. OKOŃ-HORODYŃSKA. Wydawnictwo Uczelniane Akademii Ekonomicznej im. Karola Adamieckiego w Katowicach, Katowice.

QUAH D. 2003. *Digital Goods and the New Economy*. In: *New Economy Handbook*. Ed. D.C. JAMES. Elsevier Academic Press, San Diego.

POPŁAWSKI W. 2004. *Niska innowacyjność jako zagrożenie funkcjonowania sektora małych i średnich firm w Polsce*. In: *Przedsiębiorstwo we współczesnej gospodarce. Szanse i zagrożenia*. Ed. R. DOMINIAK. Wydawnictwo PG, Gdańsk.

RAO S., AHMAD A., HORSMAN W., KAPTEIN-RUSSELL P. 2001. *The Importance of Innovation for Productivity*. International Productivity Monitor, No. 2, Spring .

*Reaching Higher Productivity Growth in France and Germany*. 2002. McKinsey Global Institute.

ROMER P.M. 1986. *Increasing Returns and Long-Run Growth*. Journal of Political Economy, 94(51).

SZABO K. 2002. *Gospodarka „cegły i klawiatury". Zanikające granice pomiędzy sektorem IT a sektorem produkcyjnym*. In: *„Nowa gospodarka" i stare problemy. Perspektywy szybkiego wzrostu w krajach posocjalistycznych*. Eds. G.W. KOŁODKO, M. PIĄTKOWSKI. Wydawnictwo WSPiZ im. Leona Koźmińskiego, Warszawa.

*The Economic Impact of ICT, Measurement, Evidence and Implications*. 2004. OECD, Paris.

*The Knowledge-Based Economy*. 1996. OECD, Paris.

*The New Economy. Beyond the Hype*. 2001. OECD, Paris.

*US Productivity Growth 1995–2000*. 2001.Understanding the Contribution of Information Technology Relative to Other Factors, McKinsey Global Institute, Washington D.C.

VARIAN H.R. 2002. *Market Structure in the Network Age*. In: *Understanding the Digital Economy. Data, Tools, and Research*. Eds. E. BRYNJOLFSSON, B. KOHIN. The MIT Press.

VARIAN H.R. 2001. *High-Technology Industries and Market Structure*. In: *Economic Policy for the Information Economy*, A Symposium Sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 30 – September 1.