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The Knowledge-based Economy as a Stage in the Development of the Economy

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Keywords: *knowledge-based economy; Toffler's waves of civilization; Schumpeter's waves of innovation*

Abstract: *The major objective of this article to attempt to show the model of a knowledge-based economy (KBE) as a stage in social, economic and institutional transformation, which has already been reached by highly developed economies. The research problem considered is examined against the background of the concepts A. Toffler's waves of civilization and, J.A. Schumpeter's waves of innovation with the use of the elements of historical and comparative analyses. The introduction outlines the context, objectives and the reasons for taking up the topic. The main part of the article presents the process of the evolution of the economy from a model of the agrarian economy, through the industrial and service-based economies to the knowledge-based economy and describes in detail the three stages of advancement of the knowledge-based economy with corresponding metrics. The last paragraph of the article presents the conclusions drawn from the analyses.*

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Introduction

Creating innovative concepts of economic growth and socio-economic development by economists, based on the broadly understood human capital factor, coincided in time with the considerations about the civilizational breakthrough that we can witness now, and whose eloquent expression is the formation of a completely new type of economy and the accompanying fundamental social, economic and institutional changes. It appears that strong foundations for the multifaceted transformation were established by the effects of the technological revolution and the related rapid development of information technology and telecommunications from the turn of the twentieth and twenty-first centuries, rapidly progressive processes of globalization and internationalization, as well as by the intensely growing competition, both at the national and international levels. However, what undoubtedly became a cornerstone for the idea of building a new type of economy was the redefinition of the meaning of tangible and intangible resources, and consequently the assumption that the overriding determinant of modern production, and even the only sustainable source of a long-term competitive advantage of the country today is human capital, which is a carrier of such key intangible factors for the economy as knowledge, science, technological progress and the effective use of information (Balcerzak 2011, pp. 456-467; Balcerzak, 2009, p. 17; Liberska, 2002, p. 31; Rosati, 2007, p. 21; OECD, 2000, p. 99).

This radical change in thinking about the determinants of national wealth has started a process of gradual reorientation of highly developed economies towards a knowledge-based economy (KBE) in which the production, distribution and implementation of knowledge (as three interrelated specific management processes) become the main driving force of socio-economic development, and where the traditional growth factors - land, labour and physical capital - are something of secondary importance, acting only as limiting conditions (Drucker, 1999, pp. 40-42; Madrak-Grochowska, 2013, p. 358; Balcerzak & Rogalska 2008, pp. 71-87).

In the author's opinion it is impossible to understand fully the essence of the transformation process described above without linking it to the previous economic models and without positioning it in the proper historical context. Moreover, it appears that the omission of historical analysis when discussing KBE can lead to an erroneous impression of the artificiality or the abstraction of this model of economy. For this reason, the objective of this article is to attempt to show KBE as the next stage of a continuous, lasting for thousands of years process of economic transformation and as one of the many stages of the social, economic and institutional transfor-

mation that is now gradually being joined by the highly developed economies, and which at the same time – similar to other steps – will probably soon pass and be replaced by something new.

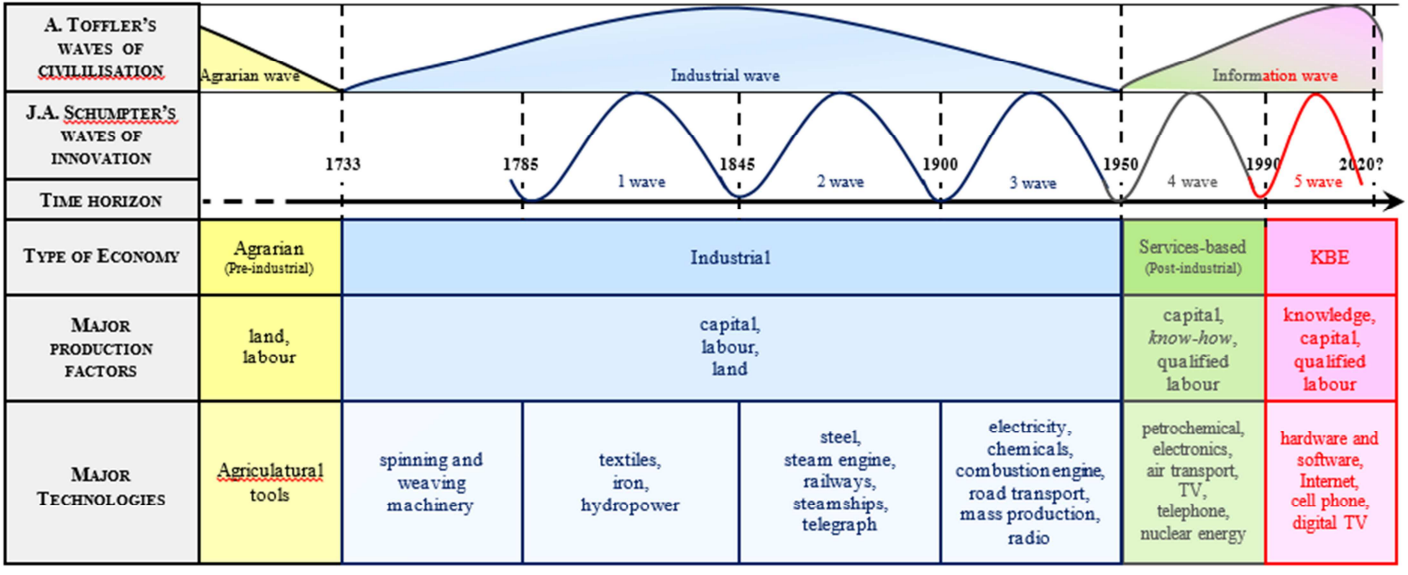
Research Methodology

The research problem considered is examined against the background of the concepts of A. Toffler's waves of civilization and J.A. Schumpeter's waves of innovation with the use of the elements of historical and comparative analyses. In addition – in order to facilitate the understanding of the considered content and the visibility of the findings of the research – the article is enriched with two figures.

The Process of the Evolution of the Economy From the Model of an Agrarian Economy to the Knowledge-based Economy

A specific perspective of considering the KBE phenomenon outlined in the introductory part of the article makes many economists connect the creation of this type of economy with the idea of clashing waves of civilization of A. Toffler, which describe the fundamental and significant changes initiated by the discoveries and transformations that constitute turning points in the history of mankind. Others are oriented towards attempts to explain the concept of the knowledge-based economy and the search for the factors that led to its birth, through reliance on J.A. Schumpeter's heuristic theory of waves of innovation. Each of the waves refers to breakthrough innovations which gave rise to a new era. Some researchers are inclined by the perspective to conclude that KBE is no artificial or bizarre creature, but a natural and even an indispensable consequence of the lasting for many centuries evolution of socio-economic systems, the development of the theory of economic growth and developments of the key production factors and determinants of national wealth over time (Piech, 2004c, pp. 209-210; Wronkowska, 2004, p. 423; Klepacz & Żółtowska, 2011, pp. 226-227). All the approaches cited here seem to be very interesting, and most importantly, analysed together allow for a more profound, accurate and multi-layered exploration of the KBE phenomenon. For this reason, all of them are presented in various parts of Figure 1, showing the place of KBE in the economic history of the world and the process of the transformation of economies from agrarian economies, through industrial and service ones, to the

Figure 1. The process of the evolution of the economy from the model of an agrarian economy to the knowledge-based economy



Source: elaborated by the author based on Kukliński (2001, p. 14), Piech (2004b, pp. 184-185), Klepacz & Żółtowska (2011, p. 227).

knowledge-based economy, along with a simple comparative analysis of these types of economies.

The discussion of the figure above and the presentation of other tracks followed for centuries by national economies, should be started with the first wave of civilization highlighted by A. Toffler, *i.e.*, with the agrarian wave. Its origins can be linked to the emergence of pioneering 'inventions' in the form of primitive agricultural tools some ten thousand years ago, which gave impetus to the development of skills related to the cultivation of the soil, and consequently led to the spread of a sedentary lifestyle. During this wave (in the Middle Ages) the agrarian economy was born (also called pre-industrial), in which the basis for building wealth and creating structures of politics, culture, society and family was possessed land. The majority of the population was attached to it and used to work in agriculture, hunting, fishing and inbreeding. Moreover, this type of economy was characterised by simple division of labour, lack of specialization and a high degree of decentralization. Apart from land, labour supported by winches, cranes, jacks, presses and draft animals was considered to be the main factor of production (Brazda, 2003, p. 66 ; Noga, 2000, p. 56).

As can be seen in Figure 1, at the turn of the seventeenth and eighteenth centuries the agrarian wave started to give way to the second wave of civilization defined by A. Toffler as 'industrial'. This truly revolutionary phenomenon of the clash of the two waves resulted from the violent social and economic transformations that began about three hundred years ago in the then richest countries of the world. These changes, in particular the dramatic increase in population, the constantly growing and difficult to meet demand, and the unprecedented development of science, became a strong stimulus for the subsequent epoch-making inventions, generating extremely intense advances in technology, industry, and communications. They also gave rise to a new type of economy, *i.e.*, the industrial economy, under which such production factors such as capital, land and labour were considered the most important determinants of economic growth, the main determinants of national wealth and international expansion. A striking symbol of this type of economy became non-renewable fossil fuels (such as coal, natural gas and petroleum), large factories and omnipresent centralization, concentration, specialization, standardization and synchronization. In addition, the main trend in the industrial economy was determined by the mass scale and uniformity of many areas of life, including, in particular, production, consumption, education, communications, and even the culture and customs (Polowczyk, 2007, pp. 40-41). In addition, the characteristic of the economy was also progressing at a rapid pace and large-scale migration

of people from rural to urban areas and systematic increases in employment in non-agricultural sectors.

When analysing more profoundly the various stages of the industrial wave shown in Figure 1, it can be said that its symbolic beginning dates back to 1733, when J. Kay invented the weaving machine (called 'Mechanical flying shuttle'), which, together with several other innovations, caused a real weaving industrial revolution, and later in spinning (Blaug, 1994, p. 81). Fifty years later, there was another breakthrough which, within the concept of J.A. Schumpeter's waves of innovation, is usually referred to as 'the first wave'. It was a period stimulated by the diffusion in the world's richest economies of J. Watt's modernized steam engine, the drive in the form of water wheels, and by the application of both of these inventions in the textile industry. At the same time, there was an intense increase in the importance of mining and metallurgy, and the result building on a massive scale blast furnaces for smelting iron ore into pig iron. According to J.A. Schumpeter's, the second wave of innovation was commenced in 1845 and lasted fifty-five years. It coincided in time with the development of new methods for the production of steel and with a much wider use of the steam engine in many areas of the economy, in particular, using it to build locomotives and steamships. These significant achievements in a short period led to intensive development of the railway network and water transport, thereby improving communication and largely satisfying the needs of faster and more frequent transport of people, raw materials, and of goods. It was also at that time when the famous invention of S. Morse, *i.e.*, the electromagnetic telegraph, grew in popularity, allowing the transfer of information and communication at a distance. Finally, in 1900 a fifty-year period of J.A. Schumpeter's third wave of innovation began. At the same time, it was the last stage of the industrial wave for many of the highly developed economies. This period gave a number of epoch-making inventions, including the combustion engine, dynamite, bulb and radio, which irreversibly changed the face of the then existing industry, enabling the development of new, previously unknown branches and introducing significant improvements in existing ones (Wronkowska, 2004, pp. 423-425; Ciborowski & Grabowiecki, 2004, pp. 172-173; Kuklinski, 1999, pp. 20-23; Milczarek, 2004, p. 12).

Further analysis of Figure 1 leads to the conclusion that in the mid-twentieth century the richest countries of the world saw a confrontation of the industrial wave with a new one - the ongoing wave of civilization called by A. Toffler 'the wave of information'. The first forty years of its existence, *i.e.*, the period from 1950 to 1990, is usually referred to as J.A.

Schumpeter's fourth wave of innovation[1] and is a consequence of the prevalence of the invention of the telephone, television and the jet engine, and using them on a large scale in the broadly understood communications and air transport. This wave was also closely connected with the rapid development of the petrochemical industry and the electronics and the emergence of entirely new industries (including the high-tech sector, nuclear power and renewable energy), and even with the implementation of the first successful attempts to conquer space.

At the same time, in many highly developed countries a new type of economy began to operate. This economy was called 'the service (or post-industrial) economy' and was distinguished by a predominance of employment and production in the services, trade, finance, and science sectors as well as by systematic departing from mass production to short series of customized products. A characteristic feature of this type of economy was also a radical change in thinking about the key factors for growth and competitive advantage, which included primarily capital, know-how and qualified workforce (Wronkowska, 2004, pp. 423-425; Piech, 2004a, pp. 37-38; Klepacz & Żółtowska, 2011, p. 227; Brazda, 2003, p. 66).

Finally, as indicated in Figure 1, at the turn of the twentieth and twenty-first centuries J.A. Schumpeter's fifth wave of innovation began to emerge, which in a special way has encompassed the world's highly developed economies, and which, according to some futurists' forecasts is to end around 2020. This wave was initiated by the global technological revolution, which manifests itself in quickly expanding digital networks, the rapidly spreading modern information and telecommunication systems, and in intensified research on renewable energy sources. In addition, the revolution has been strengthened by extremely rapid growth in personal computers, software, products and services related to advanced technologies, as well as in the popularity of new media, including, in particular, the Internet, mobile phones or digital television (Wronkowska, 2004, pp. 423-425; Piech, 2004a, pp. 37-38; Klepacz & Żółtowska, 2011, p. 227; Polowczyk, 2007, p. 42). What is particularly important, all of these technologies have already impacted substantially various fields of economic and social lives, thus laying the foundations for a new type of economy and a new type of society[2], while being at the same time a source of all kinds of challenges, opportunities and threats.

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[1] Against the background of the original theory of J. Schumpeter's waves of innovation, the following names were created and used in this article: the fourth, fifth and the next wave of the Schumpeterian type.

[2] What is meant is the so-called information society characterized by integral preparation and abundant skills in the scope of the use of the latest information and communication

In this context the phenomenon of J.A. Schumpeter's fifth wave may be combined with another fundamental institutional transformation in history, from one type of economy to a completely different one (Atkinson, 2005, p. 3), *i.e.*, with the birth of the economy referred to in this article as KBE, the base of which and the most important factor of production and competitive advantage is the high degree of knowledge, inextricably linked to the category of human capital. The consequence of the recognition of this intangible asset as a primary determinant of economic growth and development – exceeding even the capital and highly skilled workforce, as shown in Figure 1 - is basing the KBE structures on a specific economic-institutional system (effectively supporting manufacturing processes, absorption, transmission and utilization of knowledge) and on the educated and enterprising society, an effective system of innovation and dynamic information structure[3]. In addition, comparing J.A. Schumpeter's fifth wave and KBE with the previous waves and the types of economies functioning throughout their duration, it needs to be stated that a characteristic feature of KBE is a very strong and dynamic process of departing from the principles of standardization and concentration to decentralization, the large diversity of production, consumption and to other spheres of life as well as the growing importance of exports and international links. Symptomatic of KBE are also much larger than before investments in research and development, and the rapid increase in the share of employment in knowledge-intensive industries and created primarily by high-technology industries, science, education, business services, and the knowledge related to the information technology sector (Gorzelak & Olechnicka, 2003, p. 122; Herman, 2003, p. 144; Przygodzki, 2011, p. 33). Moreover, a significant trend of KBE is also a kind of 'rooting' of society in the ubiquitous, virtual network, a kind of 'technologization' of relationships and the reorganization of commonly available means of information exchange in the direction of digital communications, for which neither distance nor even time are no longer any serious barriers (Benkler, 2008, pp. 20-21; Kelly, 2001, p. IX; Polowczyk, 2007, p. 42).

At this point, however, it must be emphasized that the described process of the emergence of J.A. Schumpeter's successive waves of innovation and the related systemic transformations do not occur in all countries of the world simultaneously. The analysed phenomena occur in different countries

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solutions, fully computerized and capable of using ICT services in order to generate a significant portion of national income. More information about this type of society see in Goban-Klas & Sienkiewicz (1999); Nowak (2005); Karlik (2007, pp. 89-98).

[3] More on the KBE pillars see in Violinist (2011, pp. 270-285); Madrak-Grochowska (2010, pp. 37-54); Madrak-Grochowska (2013, pp. 357-369).

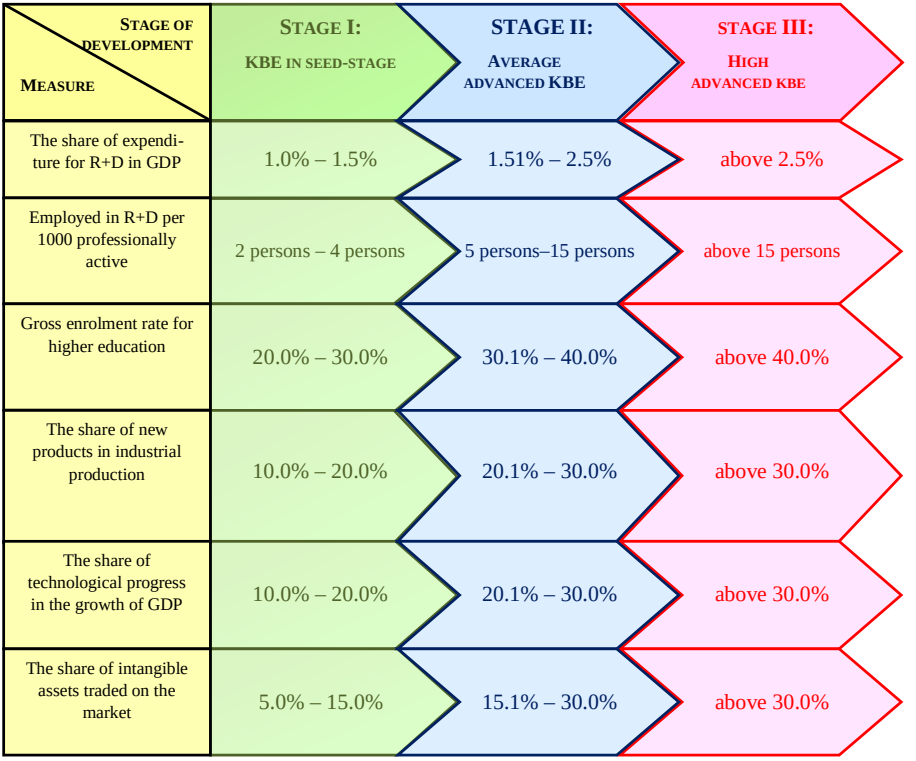
at different rates and in varied ways, the proof of which may be even the differences in the levels of economic and social development of individual countries, their positions on the international market or their dominant type of economy (Wronkowska, 2004, p. 423).

Stages of Development of a Knowledge-based Economy

An interesting fact is that even those countries that have already been embraced by the so-called J.A. Schumpeter's fifth wave, do not display precisely the same economic model. It is possible to distinguish among them national economies that are not yet on the path of building the knowledge-based economy, as well as those that are characterized by varying degrees of its development - from the seed form of KBE to the medium or highly advanced forms. A simplified description of these forms and stages of development of the knowledge-based economy along with key metrics evaluating the degree of the advancement of KBE is shown in Figure 2.

According to its content, the seed stage of KBE occurs when in a country from 1% to 1.5% of its GDP is allocated to research and development per year, and when at least two people per one thousand of the economically active are employed in the R&D sector. Such a policy of the country means spending, first of all, significant amounts and implementation of concrete actions aimed at the creation of favourable conditions for the economy to generate knowledge and build a favourable climate for the broadly understood innovation. Obviously, the successive conducting of the aforementioned undertakings requires a strong foundation in the form of a well-educated population, mainly characterized by a relatively high gross enrolment rate for higher education, reaching the level of 20% – 30%. Moreover, if a national economy is to follow the path of building a knowledge-based economy, it must also be distinguished by the visible effects of the knowledge created and its application in business practice. The theory particularly focuses on the fact whether a state has a sufficiently high proportion of new measures (*i.e.,* not older than three years) of manufactured goods, the share of technical progress in the growth of GDP, and the share of intangible assets in the turnover on market, and the first two should oscillate in the range of 10% – 20%, and the third should obtain the value of 5% – 15% (Madej, 2006, pp. 27-28; Poskrobko, 2011, pp. 43-44).

Figure 2. Stages of development of KBE and the key metrics



Source: elaborated by the author based on Czajka (2011, p. 92); Madej (2006, pp. 27-28); Poskrobko (2011, pp. 43-44).

According to the scheme shown in Figure 2, entering the second stage of the development of the knowledge-based economy by a state means exceeding all of the values relative to the first stage. In particular, this means that in a given national economy amounts earmarked for R&D activities throughout the year should reach 1.51% – 2.5% of GDP, and the number of R&D employees working in the field of knowledge and capable of making appropriate use of these outlays is within 5 - 15 people per one thousand of the economically active. A very important condition for a country to achieve an intermediate level of the advancement of KBE is also providing high-quality public education and having 30.1% – 40% of people within higher education system (calculations made following the standards of the gross enrolment rate). The consequence of these significant results in the generation and transmission of knowledge in the second stage of the development of the knowledge-based economy should be equally impres-

sive effects of applying knowledge in the process of building national wealth. This should be manifested primarily in the form of high values (reaching the level of even 30%) of the proportion of new products in the sales of manufactured goods, the share of technical progress in the growth of GDP, and the share of intangible assets traded on the market (Madej, 2006, pp. 27-28; Czajka, 2011, p . 92).

Finally, in accordance with the data presented in Figure 2, a country can boast of the functioning of a highly advanced knowledge-based economy within it structures, if it leads pro-innovation, knowledge-generating economic, educational, social and labour market policies effectively and on a very large scale. Such policies require substantial expenditure on R&D operations achieving annually more than 2.5% of GDP. Characteristic of this type of economy is also a definitely high rate of employment in the knowledge sector (more than fifteen people per one thousand of the economically active) and a gross enrolment rate at the level of higher education exceeding 40%. In addition, at this stage of the development of KBE, it is also necessary to exceed the thirty-percent threshold in each of the three main indicators reflecting the share of knowledge in the creation of GDP, namely, in the measure of the share of new products in industrial production, the share of technical progress in the growth of GDP and the share of intangible assets traded on market (Madej, 2006, pp. 27-28; Czajka, 2011, p. 92; Poskrobko, 2011, pp. 43-44). Furthermore, in accordance with the opinion of J. Kleer – a measure of GDP *per capita* shaped at a level not less than 20,000 USD, calculated according to the purchasing power parity (Kleer, 2003, p. 299), must be considered additionally as the marginal value (*i.e.*, the minimum value) of reaching by the state the third and the highest level of the advancement of KBE.

Conclusions

The following conclusions can be drawn from the presented historical analysis of the fundamental socio-economic transformation leading to the creation of a KBE model for highly developed economies: firstly, the analysis confirms the belief that the process of profound system changes each time is triggered and driven by global breakthrough inventions as well as by product, technological or organizational innovations, irreversibly changing the face of the many areas of economic and social life. Secondly, it clearly indicates that the described socio-economic transformations are a natural consequence of the earlier of Schumpeter's waves, and therefore carry in themselves a kind of baggage of centuries of knowledge and experience.

Finally, the analysis conducted also shows that further systemic changes occur in an increasingly violent and turbulent way, and the overall development of civilization on a historic scale is accelerating rapidly, which results in a highly volatile environment and the need for a quick response to the changes taking place (Balcerzak, 2009, p. 12; Klepacz & Żółtowska, 2011, p. 226; Kozmiński, 2004, p. 39). It can be seen through the prism of the successive shortening of J.A. Schumpeter's waves of innovation, the first of which lasted for sixty years, and the fifth one, related to the knowledge-based economy, according to forecasts, is to last about half the time less, *i.e.*, nearly thirty years.

Of course, the whole process of transformations of civilization does not stop there. In some scientific circles it is predicted that already around the year 2020 under the KBE conditions another wave (even shorter), the sixth wave of the Schumpeterian type will start to emerge. For this wave the major developmental factor will be innovations in the field of nanotechnology, biotechnology, genetics, mechatronics and grid networks (Brazda, 2003, p. 68) which are typically 'knowledge-absorptive'. Therefore, the following statement can be risked: the knowledge that has been accumulated for centuries, under the KBE conditions is extremely fertile ground for the effective development and implementation, and the result may be a phenomenon that the next generations will create knowledge which in its size and uses will exceed the one that was the result of the cumulative actions of all the previous generations (Boehlke, 2005, pp. 30-31; Ryszkiewicz, 2004, p. 14).

References

Atkinson, R. D. (2005). *The Past and Future of America's Economy: Long Waves of Innovation that Power Cycles of Growth*. Waszyngton: Edward Elgar.

Balcerzak, A. P. (2011). Taksonomiczna analiza jakości kapitału ludzkiego w Unii Europejskiej w latach 2002-2008. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, Taksonomia 18 Klasyfikacja i analiza danych – teoria i zastosowania*, Nr 176.

Balcerzak, A. P. (2009). Znaczenie wiedzy i innowacyjności w warunkach nowej globalnej gospodarki.In A. P. Balcerzak, E. Rogalska (Eds.). Przedsiębiorstwo w warunkach globalnej konkurencji. Toruń: Wydawnictwo Adam Marszałek.

Balcerzak, A. P. (2009). *Państwo w realiach „nowej gospodarki". Podstawy efektywnej polityki gospodarczej w XXI wieku*. Toruń: Wydawnictwo Adam Marszałek.

Bacerzak, A. P. & Rogalska, E. (2008). Ochrona praw własności intelektualnej w warunkach nowej gospodarki. *Ekonomia i prawo*, 4.

Benkler, Y. (2008). *Bogactwo sieci*. Warszawa: Wydawnictwa Akademickie i Profesjonalne.

Blaug, M. (1994). *Teoria ekonomii. Ujęcie retrospektywne*. Warszawa: Wydawnictwo Naukowe PWN.

Boehlke, J. (2005). Prawo Moore'a, gospodarka oparta na wiedzy, globalizacja – wyzwania dla ekonomicznej teorii firmy. In B. Godziszewski, M. Haffer & M. J. Stankiewicz (Eds.). Wiedza jako czynnik międzynarodowej konkurencyjności w gospodarce. Toruń: Towarzystwo Naukowe Organizacji i Kierownictwa „Dom Organizatora".

Brazda, K. (2003). Czwarta fala. *Wprost*, 15(1063).

Ciborowski, R. & Grabowiecki, J. (2004). Innovation and technological competitiveness of Central and East European Countries. In K. Piech (Ed.). The Knowledge-Based Economy in Transition Countries: Selected Issues. Londyn: School of Slavonic and East European Studies, University College London.

Czajka, Z. (2011). *Gospodarowanie kapitałem ludzkim*. Białystok: Wydawnictwo Uniwersytetu w Białymstoku.

Drucker, P. F. (1999). *Społeczeństwo pokapitalistyczne*. Warszawa: Wydawnictwo Naukowe PWN.

Goban-Klas, T. & Sienkiewicz, P. (1999). *Społeczeństwo informacyjne: Szanse, zagrożenia, wyzwania*. Kraków: Wydawnictwo Postępu Telekomunikacji. http://informacjacyfrowa.wsb.edu.pl/pdfs/SpoleczenstwoInformacyjne.pdf (05.03.2015).

Gorzelak, G. & Olechnicka, A. (2003). Innowacyjny potencjał polskich regionów. In L. Zienkowski (Ed.), Wiedza a wzrost gospodarczy. Warszawa: Wydawnictwo Naukowe SCHOLAR.

Herman, A. (2003). Zarządzanie wartością przedsiębiorstwa w gospodarce opartej na wiedzy. In I. K. Hejduk (Ed.). Przedsiębiorstwo przyszłości – nowe paradygmaty zarządzania europejskiego. Warszawa: Wydawnictwo Instytutu Organizacji i Zarządzania w Przemyśle ORGMASZ.

Karlik, M. (2007). Społeczeństwo informacyjne w globalnej przestrzeni. In E. Okoń-Horodyńska (Ed.). Człowiek i społeczeństwo w obliczu globalizacji. Kraków: Wydawnictwo Uniwersytetu Jagiellońskiego.

Kelly, K. (2001). *Nowe reguły nowej gospodarki. Dziesięć przełomowych strategii dla świata połączonego siecią*. Warszawa: WIG-Press.

Kleer, J. (2003), Czym jest G.O.W.? In A. Kukliński (Ed.). Gospodarka oparta na wiedzy. Perspektywy Banku Światowego. Warszawa: Biuro Banku Światowego w Polsce, Komitet Badań Naukowych.

Klepacz, H. & Żółtowska, E. (2011). Uwagi o standardach kształcenia w Polsce w świetle wymogów gospodarki opartej na wiedzy. In B. Poskrobko (Ed.). Gospodarka oparta na wiedzy. Materiały do studiowania. Białystok: Wyższa Szkoła Ekonomiczna w Białymstoku.

Koźmiński, A. K. (2004). *Zarządzanie w warunkach niepewności*. Warszawa: Wydawnictwo Naukowe PWN.

Kukliński, A. (1999). Unia Europejska jako przełomowe wyzwanie dla Polski XXI wieku (artykuł dyskusyjny). *Studia Europejskie*, 1.

Kukliński, A. (2001). Gospodarka oparta na wiedzy jako wyzwanie dla Polski XXI wieku (szkic memoriału). In A. Kukliński (Ed.). Gospodarka oparta na wiedzy. Wyzwanie dla Polski XXI wieku. Warszawa: Komitet Badań Naukowych.

Liberska, B. (2002). Współczesne procesy globalizacji gospodarki światowej. In B. Liberska (Ed.). Globalizacja. Mechanizmy i wyzwania. Warszawa: Polskie Wydawnictwo Ekonomiczne.

Madej, Z. (2006). Gospodarka oparta na wiedzy wkracza w świat paradygmatów. In E. Frejtag-Mika (Ed.). Teoria i praktyka ekonomii a konkurencyjność gospodarowania. Warszawa: Difin.

Madrak-Grochowska, M. (2010). Filary polskiej gospodarki opartej na wiedzy. In A. P. Balcerzak & E. Rogalska (Eds.), Stymulowanie innowacyjności i konkurencyjności przedsiębiorstwa w otoczeniu globalnej gospodarki wiedzy. Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Madrak-Grochowska, M. (2013). Konkurencyjność gospodarek opartych na wiedzy. Propozycja pomiaru. *Ekonomia i Prawo*, 13(3), http://dx.doi.org/10.12775/EiP.2013.027.

Milczarek, D. (2004). Unia Europejska a globalizacja. *Studia Europejskie*, 3.

Noga, M. (2000). *Makroekonomia*. Wrocław: Wydawnictwo Akademii Ekonomicznej im. O. Langego.

Nowak & J. S. (2005). Społeczeństwo informacyjne – geneza i definicje. In G. Bliźniuk, J. S. Nowak (Ed.). Społeczeństwo informacyjne 2005, Katowice: Polskie Towarzystwo Informatyczne Oddział Górnośląski.

OECD (2000). *Knowledge Management in the Learning Society*. *Education and Skills*. Paryż: Centre for Educational Research and Innovation.

Piech, K. (2004a). Gospodarka oparta na wiedzy i jej rozwój w Polsce. *e-mentor*, 4(6).

Piech, K. (2004b). Gospodarka oparta na wiedzy jako etap przemian społeczno-gospodarczych krajów transformacji systemowej. In J. Nowakowski & A. Skowronek-Mielczarek (Ed.). Gospodarka, przedsiębiorstwo i konsument a wyzwania europejskie. Warszawa: Szkoła Główna Handlowa.

Piech, K. (2004c). Gospodarka oparta na wiedzy w Polsce i w Zachodniej Europie z punktu widzenia zmieniającej się roli kapitału. In W. Tarczyński (Ed.). Rynek kapitałowy w przededniu integracji Polski z Unią Europejską. Szczecin: Polskie Towarzystwo Ekonomiczne.

Polowczyk, J. (2007). Trzecia fala, czyli jak Alvin Toffler przewidział moherowe berety. *Polityka*, 16 (2601).

Poskrobko, B. (2011). Wiedza i gospodarka oparta na wiedzy. In B. Poskrobko (Ed.). Gospodarka oparta na wiedzy. Materiały do studiowania. Białystok: Wyższa Szkoła Ekonomiczna w Białymstoku.

Przygodzki, Z. (2011). Region wiedzy – wiedza i kapitał ludzki a rozwój regionu. In A. Nowakowska, Z. Przygodzki, & M. E. Sokołowicz (Eds.). Region w gospodarce opartej na wiedzy. Kapitał ludzki – Innowacje – Korporacje transnarodowe. Warszawa: Difin.

Rosati, D. (2007), Wiedza a rozwój gospodarczy. In D. Rosati (Ed.). Gospodarka oparta na wiedzy. Aspekty międzynarodowe. Warszawa: Oficyna Wydawnicza Wyższej Szkoły Handlu i Prawa im. Ryszarda Łazarskiego.

Ryszkiewicz, M. (2004). Przyszłość w wykładniczym świecie. *Polityka,* 50 (2482).

Skrzypek, E. (2011). Gospodarka oparta na wiedzy i jej wyznaczniki. *Nierówności społeczne a wzrost gospodarczy. Społeczeństwo informacyjne – regionalne aspekty rozwoju*, 23.

Wronowska, G. (2004). Gospodarka oparta na wiedzy jako etap ewolucji współczesnej gospodarki. In A. Manikowski & A. Psyk (Ed.). Unifikacja gospodarek europejskich: szanse i zagrożenia. Warszawa: Wydawnictwo Naukowe Wydziału Zarządzania.