

The Knowledge-Based Economy: Evolution of Research and Stage of Development in Europe and Romania

Cătălina Florentina ALBU¹
Ștefan Cătălin POPA²
Cezar Petre SIMION³

Abstract

The knowledge-based economy represents a consequence of technological and informational progress. The performances of the economies have lately depended on the way in which knowledge is capitalizing, and also on the innovation degree and the efficiency of information flows. The present paper aims to identify the importance, characteristics and main elements of the knowledge-based economy, but also the evolution of scientific research conducted in the field of knowledge-based economy in the last 15 years. At the same time, the study aims to identify the development stage of the knowledge-based economy in Europe, and also following the particular case of Romania. The study also presents the connections of the knowledge-based economy with the RDI system and the transfer of new technologies. The knowledge-based economy has proven to be a relatively new concept, and the resources and implications of this new economy have not yet been exhausted. Regarding the development stage of the knowledge-based economy in different European countries, the differences are significant, some countries being far from capitalizing on knowledge, because they do not invest enough in development, research and innovation process.

Keywords: Europe, innovation, knowledge-based economy, R&D, technology

JEL classification: F63, O32, D89

DOI: 10.24818/RMCI.2020.2.265

1. Introduction

In the context of Information and Communication Technology (ICT) evolution and the growing research and development capacity among organizations, but also as a result of the reconsideration of human capital as the key to innovation, creativity and the generation of new ideas, there were a number of changes in the economic environment at the end of the 19th century, whose main pillars were knowledge and information, which led to the replacement of the concept of "industrial society" with that of "knowledge society". The knowledge society is a new state of modern society, evolving, developed under the pressure of

¹ Cătălina Florentina Albu, The Bucharest University of Economic Studies, Romania, email: catalina.albu@man.ase.ro

² Ștefan Cătălin Popa, The Bucharest University of Economic Studies, Romania, email: catalin.popa@man.ase.ro

³ Cezar Petre Simion, The Bucharest University of Economic Studies, Romania, email: cezar.simion@man.ase.ro

increasing the interdependence of international economies, in which knowledge is the main source of prestige, power, prosperity and well-being of its components.

The literature has focused on the study of the knowledge-based economy after 2000, when were developed the innovation, research, technology transfer and ICT, in an attempt to increase the quality and value of the economy. For example, some authors (Korres, Patsikas, & Polichronopoulos, 2002), have studied the way in which knowledge can be developed and disseminated. Later, Sukhodolov, Popkova, & Litvinova (2018), have studied the conceptual provisions of information economy theory and its essence. On the other hand, Cader (2008) studied the changes in the knowledge-based industries, that have taken place between 1991 and 2001. The study showed that the knowledge-based industries increased by 50-60% in 2001, compared to 1991.

The impact of knowledge-based economy factors on national economy growth, as well as the development level of the knowledge-based economy in different countries, have been analyzed. One study conducted by Sundać & Krmpotić (2011), aimed to identify various factors of the knowledge economy with significant impact on national economies growth, using various variables of the knowledge economy. This study was conducted on a sample of 118 countries, divided into three categories, depending on those countries' incomes (GDP per capita). The results showed that only two factors of the knowledge economy, namely education and ICT, play an important role in achieving the socio-economic development of low-income countries, while the results for middle-income countries showed that in addition to education and ICT, a third factor is important, namely Law and Institution. Ultimately, only the quality of the workforce and ICT had a positive impact on the development of high-income countries. Other authors (Skrodzka, 2016) analyzed the development level of the knowledge-based economy in EU countries. According to the results, in 2013, the country with the highest level of development of the knowledge-based economy was Sweden, followed by Denmark, Finland and Luxembourg. At the opposite pole, the countries with the lowest level of knowledge-based economy were Romania, Bulgaria and Greece.

The present study aims to identify the role, importance, characteristics and elements of the knowledge-based economy, as well as the evolution of research in the field of knowledge-based economy, in an attempt to identify the main areas of interest, which represented landmarks in different time periods. Furthermore, this paper aims to identify both the current state of development of the knowledge-based economy in Europe, taking into account aspects such as R&D (Research & Development) expenditure and R&D intensity, and also the current state of development of the knowledge-based economy, by following the particular case of Romania. Ultimately, the connections of the knowledge-based economy with the Research-Development-Innovation system and the transfer of new technologies are presented.

2. Knowledge-based economy: literature review and research evolution

The knowledge-based economy has emerged as a result of the industry's growth, the widespread application of information technologies in all economic activities, but also as a result of the increasing competitiveness of international economies. Today, the global knowledge-based economy creates both threats and significant opportunities at the level of each country (Ceptureanu, 2014). Basic concepts of the knowledge-based economy were addressed by Peter Drucker (1969), who disseminated and popularized the concept of "knowledge economy" through his book entitled "The Age of Discontinuity". Later, Romer (1986) stressed the importance of knowledge in economic growth. In 1996, the OECD (Organisation for Economic Co-operation and Development) considered that knowledge-based economies are "those that are directly based on the production, distribution and use of knowledge and information" (p. 7). At the end of the twentieth century, there were widespread demands for economic and social transformation, focused on new information technology (Room, 2005). As the primordality of knowledge, information and technology creates a knowledge-based economy, a "knowledge triangle" develops between education, research and industry. Therefore, a dynamic balance is created between the production of knowledge, the use of knowledge and the transformation of knowledge into a criterion of national and international wealth and a basic resource for economic growth (Kamara & Bousrih, 2007).

Compared to the old economy, the knowledge economy is characterized by a higher degree of risk, as a result of new valences, the increasing possibilities of changes, but also as a result of the need to adapt to these changes. The knowledge-based economy is characterized by economic globalization, technological progress, the proliferation of knowledge and information, and changes in consumer needs and preferences (Martín-de Castro, López-Sáez, & Delgado-Verde, 2011).

Some authors (Hadad, 2017) consider that the knowledge-based economy has transformed the business world by re-evaluating the role of knowledge, innovation and evolution, as a basic process of production and as a determining factor in business success. Other specialists (Powell & Snellman, 2004) appreciate that the knowledge economy can be defined as a fundamental need, based on intensive activities to improve knowledge flows, which contribute to an accelerated pace of technological and scientific advancement. Moreover, the general long-term trend towards a strong knowledge-based economy is considered to be accelerating (Korres, Patsikas, & Polichronopouls, 2002). Therefore, productivity, growth, workforce consolidation and strategic orientation become increasingly dependent on knowledge.

The main features of the knowledge-based economy are innovation, education, creativity and knowledge management (White, Gunasekaran, & Ariguzo, 2012). The level of investment in innovation, creativity and education has

become a dominant indication of the understanding and development of modern civilization (Powell & Snellman, 2004).

The unprecedented development of ICT, as well as innovation (in its various forms) facilitates the assertion of the knowledge-based economy (Popa, Ștefan, Morărescu, & Cicea, 2018). The knowledge-based economy has led organizations to reconsider their strategies in order to gain a competitive advantage, by considering innovation as a considerable economic advance, a new policy and mission of the organization. Innovation consists in making the most of all knowledge and information and considering new ideas and discoveries as real development opportunities. Creativity and innovation are two elements that intercondition each other, creativity becoming an essential condition in the context of the emergence of a knowledge-based economy (Hadad, 2017; Oprean-Stan, Stan, & Pele, 2018). In this respect, the inexhaustible resource - the human factor, the only factor responsible for economic development in terms of creativity, becomes a key element in strengthening the knowledge-based economy.

In terms of education, at international level, the orientation of education towards the knowledge-based economy is still being crystallized. In both developed and developing countries, education is considered to be the key to the continued growth of the national economy. On the other hand, in a knowledge-based economy, emphasis must be placed not only on the structure of the educational institution but also on its content (George, 2006).

Another particularity of the knowledge-based economy, namely knowledge management, is a process that guides organizations to find, select, organize, disseminate and transfer important information and expertise needed for activities, such as: problem solving, dynamic learning, strategic planning and decision making (Gupta, Iyer, & Aronson, 2000). At the same time, knowledge management is known as a discipline that promotes an integrated approach to the creation, capture, organization, access and use of an organization's information resources (Girard & Girard, 2015) and have a positive impact on organizations' economic and social outcomes (Popa, & Ștefan, 2019).

To identify the evolution of research in the field of knowledge-based economy over the past 15 years, the VOSviewer bibliometric analysis program (van Eck, & Waltman, 2010) was used. The analysis of the most relevant and used concepts of the field of knowledge-based economy was performed in two stages, for two periods, respectively 2005-2008 and 2014-2017. The analyses were performed by selecting scientific articles published in the fields of management, business and economics, from the databases of the Web of Science platform. The size of each item is given by the number of occurrences of each concept, the length of the link lines indicates the power of the connection between two concepts, and the thickness of the lines indicates links strength.

Research evolution in the field of knowledge-based economy between 2005 and 2008 is presented in figure 1. For this analysis, all the existing articles on WOS in the period 2005-2010 in the fields of management, business and economic

Research evolution in the field of knowledge-based economy between 2014 and 2017 is presented in figure 2. For this analysis, all the existing articles on WOS in the period 2010-2020 in the fields of management, business and economic were selected. Of the 3514 articles, the VOSviewer program selected 1087 relevant terms, and 44 of them had a direct link to the knowledge-based economy.

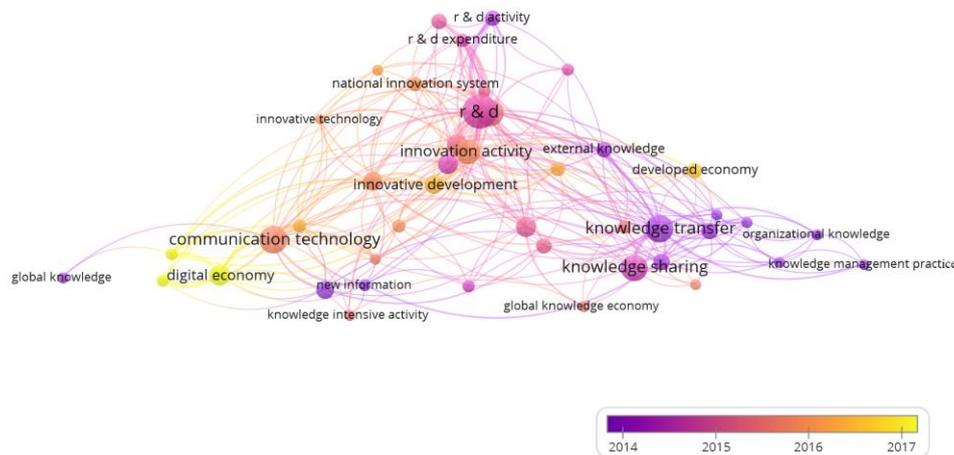


Figure 2. Research evolution in the field of knowledge-based economy between 2014 and 2017

Source: authors with VOSviewer (van Eck & Waltman, 2010)

According to figure 2, between 2014 and 2015, most research in the field of knowledge-based economy analyzed concepts such as "knowledge transfer", "knowledge management practice", "knowledge society" and "R&D" activity. Between 2015 and 2017, concepts related to innovation, and after 2017, research analyzed concepts such as "digital economy", "digitalization" and "digital technology". The central concept of the analyzed period is "R&D" (occurrences: 126, total link strength: 72). Other important concepts are "innovation system" (occurrences: 82, total link strength: 60), "communication technology" (occurrences: 78, total link strength: 43), and "knowledge transfer" (occurrences: 72, total link strength: 41).

Therefore, if in 2005-2008 period, the emphasis was on knowledge management and economic growth, in 2014-2017 period, the research has focused on communication technology, knowledge transfer and sharing. There is also an upward trend in research in the field of knowledge economy, especially in terms of R&D and innovation.

3. The stage of the development of knowledge-based economy - Europa's case

In Europe, the development stage of the knowledge-based economy is still well below the stage of development in large nations such as Japan and the United States, where investment in research and development is about 67% higher than in the Member States of Europe (Siebes, Viceconti, Maglaveras, & Kirkpatrick, 2007). Although in 2010, Europe aims to become the most competitive and dynamic knowledge-based economy, characterized by remarkable social cohesion and sustainable economic growth, studies have shown, taking into account the intensity of investment in research and development as a percentage of GDP, the fact that Europe was close to stagnation (Potočník, 2005). The key of European success in applying new technologies can be the rich diversification of talent, culture, knowledge and skills found in the Member States (European Business Journal, 2001).

While the transformations associated with the knowledge-based economy are manifesting themselves in all capitalist economies, Europe is also involved in major institutional changes. Therefore, despite the efforts made since 1980 by various programs to globalize the knowledge-based economy, European integration is not yet dominated by a science and technology policy (Archibugi & Coco, 2005).

Based on criteria such as the labor market, innovation, social equity and environmental sustainability, some authors (Tilford & Whyte, 2010) consider that European countries such as Denmark, Sweden, Finland, Austria and the Netherlands are on the first place in the top of the countries with the highest level of development of the knowledge-based economy. The next ranked countries are France, Germany, Great Britain and Scotland, and on the last place are Spain, Portugal, Greece, Italy, Romania, Poland, Hungary, Bulgaria and Malta.

Compared to another investments, investment in knowledge is much more difficult to measure (OECD, 2001). According to Uppenbergh (2010) investment in research and development have an essential contribution for the knowledge economy development, in general, and for innovation process, in particular. Figures 3, 4 and 5 show the situation of R&D expenditure in European countries, according to the latest data provided by Eurostat (2019).

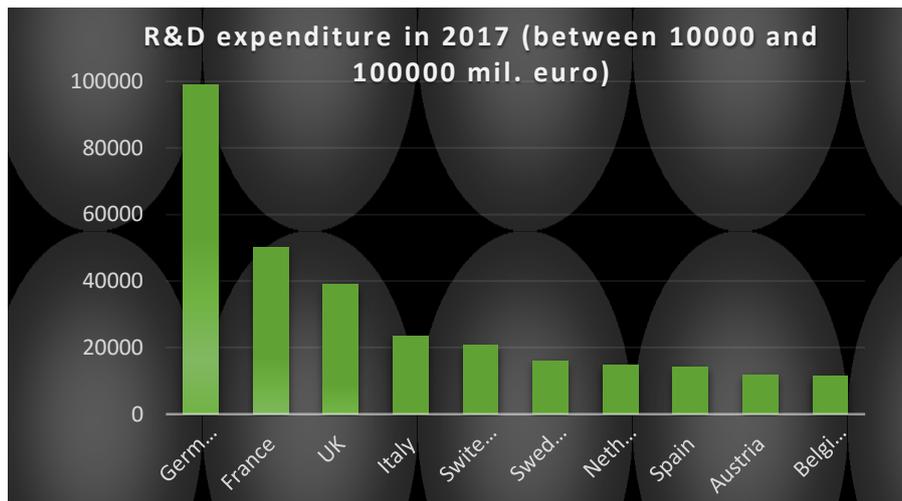


Figure 3. R&D expenditure in 2017 – countries that have invested between 10000 and 100000 mil. euro

Source: adapted by authors after Eurostat, 2019

Figure 3 illustrates the countries located at the highest level of expenditures, which invested between 10000 and 100000 mil. euro in R&D, in 2017. As can be observed, Germany was the country that invested the most in R&D (99052 mil. euro), being followed by France (50099 mil. euro) and United Kingdom (38898).

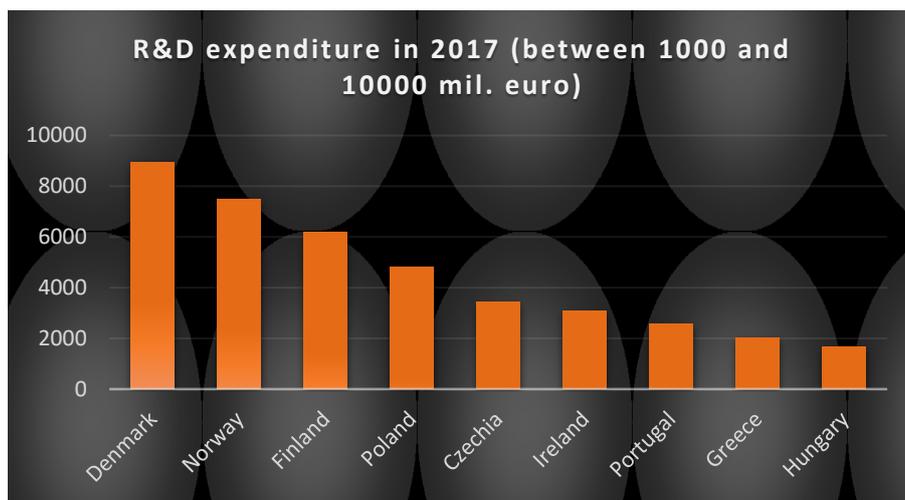


Figure 4. R&D expenditure in 2017 – countries that have invested between 1000 and 10000 mil. euro

Source: adapted by authors after Eurostat, 2019

At the middle level of investments in R&D, are located the countries presented in figure 4, which invested in 2017, between 1000 and 10000 mil. of euro. At this level, Denmark invested the most (8948 mil. euro), being followed by Norway (7474 mil. euro), Finland (6173 mil. euro) and Poland (4834 mil. euro).

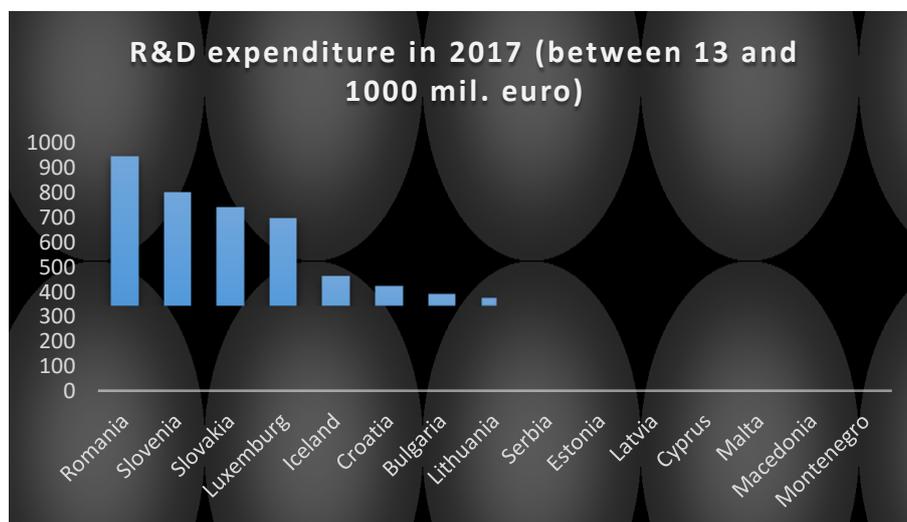


Figure 5. R&D expenditure in 2017 – countries that have invested between 13 and 1000 mil. euro

Source: adapted by authors after Eurostat, 2019

The countries that have invested the least in R&D are presented in figure 5. As can be seen, there are several countries at the bottom of R&D investment. Romania invested 945 mil. euro in R&D in 2007, and is followed by Slovenia (801 mil. euro), Slovakia (749 mil. euro) and Luxemburg (695 mil. euro). Of all the countries analyzed, those that invested the least are Latvia (138 mil. euro), Cyprus (109 mil. euro), Malta (61 mil. euro), Macedonia (36 mil. euro), and Montenegro (13 mil. euro).

For a more complex and clearer frame, figure 6 illustrates the R&D intensity (R&D expenditure as % of GDP). The highest research and development intensities were recorded in Sweden (3.33%) and Austria (3.16%), followed by Denmark (3.06%) and Germany (3.02%), all with expenditures in R&D over 3% of GDP, while Finland (2.76%), Belgium (2.58%) and France (2.25%) spent R&D between 2% and 3% of GDP. At the opposite pole are eight Member States with a research and development intensity of less than 1%: Romania (0.5%), Latvia (0.51%), Malta (0.55%), Cyprus (0.56%), Bulgaria (0.75%), Croatia (0.86%), Lithuania and Slovakia (both 0.88%). At European level, the average expenditure on research and development, as a percentage of GDP, in 2017, was about 2.05%. The target for 2020 is for these expenditures to reach 3% (Eurostat, 2019).

One priority for the development of the knowledge-based economy is to fund research and innovation. In Romania, although the financing of innovation is an essential condition for European integration, it is extremely limited compared to other European countries, where there are many facilities that promote innovation (e.g. financing through investment funds) (Caragea, Gheorghiu, & Țurlea, 2003).

Specialists (Cișmas & Sirghi, 2009) consider that it is important to establish and prioritize certain objectives for the Romanian economy development, and especially the knowledge-based one, through investments in education, entrepreneurship support, creation of research centers, leading to the creation of new technologies for the development of society. In this regard, several public policy strategies for learning and education can be considered, but also for innovation, in order to improve the knowledge-based economy, according to table 1 below.

Table 1. Public policy strategies for improving the knowledge-based economy in Romania

Public learning and education policies	Public policies for innovation
Implementing a government program that supports learning, providing financial assistance for employee training.	Implementing a government program that supports financial investments in hardware and software.
Implementing a government program to support the development of technological, industrial and organizational knowledge.	Implementing a government training program for the use of ICT in teaching and learning.
Implementing a government program to support the development of vocational schools (by providing support to students and employers).	Implementing a government program for the digitization of public services and SMEs development.

Source: adapted by authors after Hadad, 2017

5. Connections of the knowledge-based economy with the RDI (Research, Development, Innovation) system and the transfer of new technologies

The RDI system is a strategy for developing the competitiveness of the knowledge-based economy, whose object of activity is the development of science and technology, through specific research and development activities. At the level of each country, the RDI system consists of a continuous process of modernization and adaptation to existing global standards. As a result of the manifestation of a number of regulations and political and legislative factors (fragmentation of the organizational system), economic factors, social factors (lack of innovative culture, low skills of involvement in technological change) and technological factors that influence the effectiveness of the RDI system, not all countries are able to create a knowledge-based economy. Although at European level, the priority objectives in

basic research are to increase knowledge and promote industrial development and technology, as far as Romania is concerned, the knowledge-based economy is developing at a fairly slow pace, because of modest overall performance of the RDI system. Compared to other European countries, Romania is among the last places in terms of patents, innovation infrastructure, technology transfer, scientific publications (especially ISI), and the number of National Research, Development and Innovation Programs (Agachi, et al., 2006).

According to the "European paradox", the level of research in Europe is well above the existing global average, but the reason why the transfer of new technologies is still deficient is the lack of remarkable economic results (Agachi, et al., 2006). However, the Government of each country adapts and develops the knowledge-based economy by continuously streamlining research, development, innovation and technology transfer projects, but also by increasing the impact of research and innovation on the national economy.

Although new technologies play a key role in developing the knowledge economy and increasing the competitiveness of knowledge-based societies, providing significant opportunities for the storage and commercialization of knowledge and information (Cader, 2008), there are situations where the transfer of new technologies creates barriers that are difficult to overcome, which are especially related to adaptation to technological progress (Kituyi, 2018). In developing countries, in order to overcome the difficulties of adaptation, the challenges related to the integration of new technologies in modern societies and in educational institutions are discussed, establishing on the basis of best practice approaches, effective strategies that will lead to knowledge-based economy development (Sife, Lwoga, & Sanga, 2007).

6. Conclusions

The knowledge-based economy is an economy in which knowledge drives economic growth and development (Mensah & Enu-Kwesi, 2018). The knowledge-based economy is also a consequence of optimizing the global vision of the aspects related to knowledge, innovation and evolution, being at the same time a source of competitiveness in all economic sectors. The expansion of innovation combined with the widespread use of ICT has led to the development of knowledge-based economy (Engelbrecht, 2009).

Research in the field of knowledge-based economy is currently expanding and the analysis of innovation and ICT is on an upward trend. Given current trends, there is a possibility that future research will focus more on digital economy, communication technology and innovative technology.

Although in Europe, R&D investment is still well below the investment stage of large nations, there are countries that stand out, both through the R&D expenditure, and through R&D intensity, such as Germany, Sweden and Austria. Even if Romania is gradually adapting to existing trends at European level, Romania invests even 100 times less in research and development, compared to the

top countries. In order to advance effectively towards a knowledge-based economy, countries need to invest in both generation and diffusion of new knowledge (Korres, 2008).

Even though this paper presents a homogeneous image of the evolution of research conducted in the field of knowledge-based economy, and also on the current stage of development of the knowledge-based economy in Europe and Romania, more laborious comparative research is still needed on the main areas of interest included in the knowledge-based economy, but also on investment levels of another nations, such as SUA, China and Japan.

References

1. Agachi, Ș., Curaj, A., Dumitrache, I., Filip, F., Popa, G., Stănciulescu, I., & Szabolcs, L. (2006). *National Research, Development and Innovation System in the context of European research integration*. Bucharest: Romanian Academy Publishing House.
2. Archibugi, D., & Coco, A. (2005). Is Europe Becoming the Most Dynamic Knowledge Economy in the World? *Journal of Common Market Studies*, 43(3), 433-459.
3. Cader, H. A. (2008). The Evolution of the Knowledge Economy. *The Journal of Regional Analysis & Policy*, 38(2), 117-129.
4. Caragea, A., Gheorghiu, R., & Țurlea, G. (2003). *Knowledge Based Economy in Romania*. Report - Knowledge Economy Resource Center.
5. Ceptureanu, S. (2014). Knowledge based economy in Romania: comparative approach. *Journal of Applied Quantitative Methods*, 9(4), 51-61.
6. Ceptureanu, S., Ceptureanu, E., Tudorache, A., & Zgubea, F. (2012). Knowledge Based Economy Assessment in Romania. *Economics*, 15(1), 70-87.
7. Drucker, P. (1969). *The Age of Discontinuity*. Butterworth-Heinemann.
8. Engelbrecht, H. (2009). Pathological Knowledge-Based Economies: Towards a Knowledge-Based Economy Perspective on the Current Crisis. *Prometheus: Beyond the Information Revolution?*, 27(4), 403-414. doi: 10.1080/08109020903414283
9. European Business Journal. (2001). Actions for competitiveness through the knowledge economy in Europe. *13*(4), 183-186.
10. Eurostat. (2019, January 10). *R&D expenditure in the EU increased slightly to 2.07% of GDP in 2017*. Retrieved June 2, 2020, from <https://ec.europa.eu/eurostat/documents/2995521/9483597/9-10012019-AP-EN.pdf/856ce1d3-b8a8-4fa6-bf00-a8ded6dd1cc1>
11. George, E. (2006). Positioning higher education for the knowledge based economy. *Kluwer Academic Publishers*, 52(4), 589-610. doi:10.1007/S10734-005-0955-0
12. Girard, J., & Girard, J. (2015). Defining knowledge management: Toward an applied compendium. *Online Journal of Applied Knowledge Management*, 3(1), 1-20.
13. Gupta, B., Iyer, L., & Aronson, J. (2000). Knowledge Management: Practices and Challenges. *Industrial Management and Data Systems*, 100(1), 17-21. doi:10.1108/02635570010273018
14. Hadad, S. (2017). Knowledge Economy: Characteristics and Dimensions. *Management Dynamics in the Knowledge Economy*, 5(2), 202-225. doi: 10.25019/MDKE/5.2.03
15. Holban, I., & Oncioiu, F. (2009). Romania and the Knowledge-Based Economy: Innovation the Source of Economic Growth. *Economics*, 2(10), 1-24.

16. Kamara, A., & Bousrih, L. N. (2007). *Growing a Knowledge-Based Economy: Evidence from Public Expenditure on Education in Africa* (Economic Research Working Paper No. 88 ed., Vol. 88). Tunisia: African Development Bank.
17. Kituyi, M. (2018). *Technology and Innovation Report 2018 - Harnessing Technologies for Sustainable Development*. New York: United National Conference on Trade and Development.
18. Korres, G. (2008). *Technical Change and Economic Growth: Inside the Knowledge Based Economy. Inside the Knowledge Based Economy* (Vol. II). Abingdon: Ashgate Publishing.
19. Korres, G. M., Patsikas, S., & Polichronopoulos, G. (2002). A knowledge based economy, the socio-economic impact and the effects on regional growth. *Economy Informatics*, 2(1), 5-12.
20. Martín-de Castro, G., López-Sáez, P., & Delgado-Verde, M. (2011). Towards a knowledge-based view of firm innovation. Theory and empirical research. *Journal of Knowledge Management*, 15(6), 871-874. doi:10.1108/13673271111179253
21. Mensah, M., & Enu-Kwesi, F. (2018). Research collaboration for a knowledge-based economy: towards a conceptual framework. *Springer International Publishing*, 5(1), 1-17. doi:10.1186/s40604-018-0049-5
22. OECD. (1996). *The Knowledge Based Economy, OCDE/GD (96) 102*. Paris.
23. OECD. (2001). OECD Science Technology and Industry Scoreboard. Towards a Knowledge-Based Economy. Paris: *OECD Publications Service*.
24. Oprean-Stan, C., Stan, S., & Pele, A. (2018). The National Intangible Resources and their Importance in the Current Knowledge-Based Economy. *Management of Sustainable Development Sibiu*, 10(2), 45-49. doi:10.2478/msd-2019-0007
25. Potočník, J. (2005). Europe won't pay for knowledge economy. *IEE Review*, 51(9), 22-23.
26. Powell, W., & Snellman, K. (2004). The Knowledge Economy. *Annual Review of Sociology*, 199-220. doi: 10.1146/annurev.soc.29.010202.100037
27. Popa, I., Ștefan, S. C. (2019). Modeling the Pathways of Knowledge Management Towards Social and Economic Outcomes of Health Organizations. *International Journal of Environmental Research and Public Health*, 16(7), 1114, doi: 10.3390/ijerph16071114
28. Popa, I., Ștefan, S. C., Morărescu, C. & Cicea, C. (2018). Research regarding the Influence of Knowledge Management Practices on Employee Satisfaction in the Romanian Healthcare System. *Amfiteatru Economic*, 20(49), 553-566, doi: 10.24818/EA/2018/49/553
29. Romer, P. (1986). Increasing Returns and Long-Run Growth. *The Journal of Political Economy*, 94(5), 1002-1037.
30. Room, G. (2005). *The European Challenge: Innovation, Policy Learning and Social Cohesion in the New Knowledge Economy*. Great Britain: Policy Press.
31. Siebes, M., Viceconti, M., Maglaveras, N., & Kirkpatrick, C. (2007). Engineering for Health - A partner in Building the Knowledge Economy of Europe. *Exploring Exciting Frontiers in Europe*, 26(3), 53-59.
32. Sife, A., Lwoga, E., & Sanga, C. (2007). New technology for teaching and learning: Challenges for higher learning institutions in developing countries. *The International Journal of Education and Development using Information and Communication Technology*, 3(2), 57-67.
33. Skrodzka, I. (2016). Knowledge-based economy in the European Union - cross-country analysis. *Statistics in Transition*, 17(2), 281-294.

34. Sukhodolov, A., Popkova, E., & Litvinova, T. (2018). *Models of Modern Information Economy*. Bingley: Emerald Publishing.
35. Sundać, D., & Krmpotić, I. F. (2011). Knowledge Economy Factors and the Development of Knowledge-based Economy. *Croatian Economic Survey*, 13(1), 105-141.
36. Tilford, S., & Whyte, P. (2010). *The Lisbon Scorecard X: The Road to 2020*. London: Centre for European Reform.
37. Uppenberg, K. (2010). The knowledge economy in Europe - A review of the 2009 EIB Conference in Economics and Finance. *European Investment Bank*. doi:10.2867/7399
38. van Eck, N.J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84, 523–538. doi:10.1007/s11192-009-0146-3
39. White, D., Gunasekaran, A., & Ariguzo, G. (2012). The structural components of a knowledge-based economy. *International Journal of Business Innovation and Research*, 7(4), 504-518.