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The European Union's R&D potential after Brexit – Opportunities and Threats

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Abstract

Brexit poses a great challenge to the EU, whose R&D potential will be significantly weakened. In general terms, this would mean a downturn in EU research and development, considering the necessity of gaining some distance on the USA and East Asia. In the paper, the authors attempt to identify opportunities and threats to the development of R&D in the EU after Brexit. The study also aims to establish the impact of the UK on the EU in the area of R&D and the importance of the EU in the global economy as well as determining opportunities for the development of R&D potential after Brexit and possible threats arising from this process. It seems necessary to specify postulates regarding actions to avoid negative effects on the R&D potential of the EU. Therefore, directions and areas of desirable actions will be developed for strengthening EU R&D, especially in the aspect of shaping the EU's innovation policy.

Keywords: Research and development, EU industrial R&D, EU innovation policy, EU funds, Brexit, global system of R&D.

Introduction

The United Kingdom's withdrawal from the European Union involves various social and economic changes for both parties. However, no agreement has been reached with regard to specific arrangements (other than the Political Declaration) concerning bilateral EU–UK relations after 2020[1]. As early as 2017, there were first clear conditions for the necessity to design critical changes in the EU to respond to the effects of the looming Brexit for the future of a disintegrated Community. The initial step was the White Paper prepared by the European Commission (2017a) as an introduction to an in-depth discussion, the development of scenarios for the future EU-27 and the nature of the EU–UK relations. The consequences of Brexit have been widely studied and analysed from the perspective of the EU economy (Sapir et al., 2017; Huhe et al., 2017; Hix, 2018; Etiubon and Ibietan, 2018; Vandenbussche et al., 2019). Various scenarios and forecasts of the future relations between the EU and the UK have also been described by HM Government (2016), Darvas et al. (2017), Hook and Szomszor (2016), Núñez Ferrer and Rinaldi (2016), Duff (2020).

It must be pointed out, however, that relatively little attention has been given in the literature to sector-specific relations between the UK and the EU in the future; in particular, such a neglected sphere is R&D, the present-day basis for building competitiveness and innovation. Therefore, R&D is a key area in which the UK and the EU should design a favourable partnership framework to achieve permanent growth of their respective economies (Leigh et al., 2020), also bearing in mind global competition in

[1] As at 14 July 2020.

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this field from the USA and East Asia. Taking into account the impact of Brexit on EU R&D and the considerable importance of the R&D area to modern economies, this article attempts to outline possible benefits and threats in the field of R&D.

This study aims to determine the influence of Brexit on the European Union's R&D potential in the global economy from the point of view of its development opportunities and the threats involved as well as to identify measures to be taken to mitigate negative effects of Brexit s. The following research hypothesis was adopted: despite the EU's weakened position in R&D, Brexit may be an impulse to introduce changes aimed at reinforcing the EU's R&D potential.

The study is composed of two parts. Part one attempts to analyse the EU's post-Brexit position in the global R&D system. Part two discusses the issue of future relations between the EU and the UK, including the financing of R&D. The examination was conducted using the critical analysis of the existing literature and available statistical data as well as the observational and experimental methods. The statistical material was retrieved from the databases of Eurostat, the OECD and the rankings of the top business investors in R&D.

Brexit and the EU's position in the global R&D system

From the 1990s, the world's R&D system experienced major changes due to the decentralisation process; as a result, in addition to the traditional triad, developing countries gradually gained in importance as well (UNCTAD, 2005a; 2005b). After the mid-1990s, the world's top performers (the USA, Japan, Germany, France and the UK) were joined by South Korea, soon followed by China (Huang and Sharif, 2015). Therefore, the global R&D system underwent substantial changes, with a steadily growing role of East Asia (Japan, China, Korea and Taiwan), whose total expenditure on R&D exceeded that of the EU in 2004 and that of the USA in 2010. Thus, the global R&D system is based on three centres: East Asia, the USA and the EU. But other characteristic features of the system include the incessantly dynamic growth in East Asian R&D, mostly due to remarkable activities of China and Korea, and a relatively steady but minor increase in R&D spending in the USA and the EU (Figure 1).

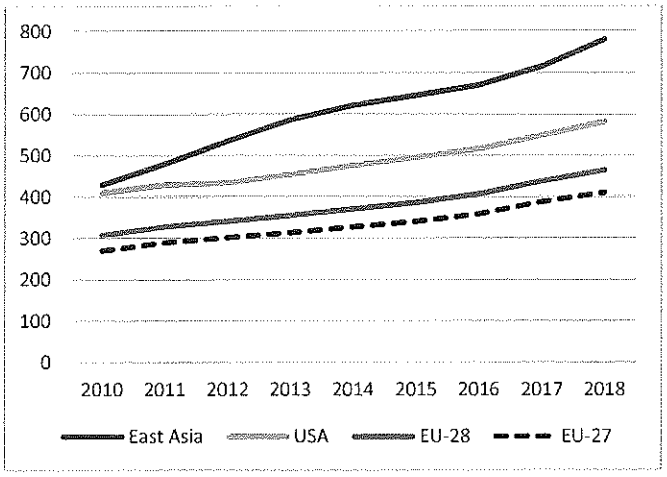

Figure 1: Three centres of global R&D – Gross Domestic Expenditure on R&D (USD billion)
Source: calculated by the authors based on OECD (2020).

In 2018, the overall R&D expenditure of the Asian centre was USD 781.1 billion, whereas the USA and the EU spent on R&D USD 581.6 billion and USD 464.9 billion respectively. It must be emphasised that the Asian centre has been clearly strengthening its position as the leader, particularly since 2016, leaving the USA and the EU increasingly farther behind. The Asian centre account for ca. 38.6% of global R&D expenditure , whereas the USA and the EU represent ca. 26.3% and ca. 20.7%

respectively. In this context, the impact of Brexit seems very alarming as the UK played a major role in building the EU's position in the global system. Figure 1 also illustrates R&D expenditure in the EU without the UK (the EU-27), which shows a marked weakening of that centre of global R&D as in 2018 the UK's spending on R&D was USD 54 billion; as a consequence, it pushed down the EU-27's share in global expenditure on R&D to ca. 18.3%.

Another significant post-Brexit threat to the EU is a distinct fall in human potential in R&D, due to the impressive resources of the UK: the R&D personnel of 463,500, including 305,800 researchers. In 2018, the EU-28 had R&D personnel of 3.3 million, including 2.1 million researchers (OECD, 2020); therefore, Brexit will involve an abrupt fall in the EU-27's human potential by ca. 14%. A decrease in human potential will undermine capabilities to create new knowledge, especially due to the EU's low efficiency: the number of researchers in the EU is higher than that in the USA (1.4 million in 2017), but the EU performs worse in the magnitude or intensity of R&D activities. In this context, the fact that after Brexit the EU-27 will still have more researchers than the USA seems to be of secondary importance. At the same time, the human potential of East Asia is impressive: R&D personnel of 6.0 million, including 3.1 million researchers in 2018 (OECD, 2020).

Therefore, Brexit gives rise to considering the issue of maintaining the EU's position as an attractive global R&D centre, or a cooperation partner for the other two centres, which will certainly pose a major challenge to the EU. It seems necessary to intensify endeavours to dynamise and speed up the EU-27's technological progress, thus to boost funding within the EU R&D policy and to improve efficiency in the area. It will be essential for individual Member States to increase efforts to boost expenditure on R&D. Although Member States have been making progress in improving innovation, it seems insufficient, as reflected in the European Innovation Scoreboard results (European Commission, 2020a). The Innovation Leaders in the EU are small economies (Sweden, Finland, Denmark, Luxembourg, the Netherlands), unable to substantially strengthen the EU's global position. Simultaneously, the largest Member States, such as Germany and France, are classified as Strong Innovators (together with Austria, Belgium, Estonia, Ireland and Portugal). Italy ranks among Moderate Innovators, the largest group of the EU Member States. Furthermore, in comparison with the other two global centres, the EU has noted the least significant progress since 2012 – 3%, against 4.9% in the USA and 17.3% in China, 15% in Korea and 8% in Japan. Therefore, Brexit has further aggravated the problem of maintaining the EU's position in the global R&D system.

The key to maintaining the EU's position seems to be stimulating cooperation in research and innovation with the UK as well as with the global R&D centres. Whereas the shape of mutual relations between the EU-27 and the UK in that area remains an open question, the EU formalised the rules of cooperation with the world's R&D leaders years ago and has gradually developed its scope and principles. The cooperation framework includes the EU–China Science and Technology Cooperation Agreement signed in 1998, again renewed and upgraded in 2018 (European Commission, 2018b); the multi-annual science and technology cooperation agreement with the USA, repeatedly updated and extended, dated 1990 (European Commission, 2018c); or the Agreement on Science and Technology Cooperation with Japan from 2011, subsequently renewed (European Commission, 2018d). Under the above-mentioned agreements, researchers from those countries participate in the EU's science and technology programmes (e.g. FP7, Horizon 2020, Euratom), whereas the established relationships favour the transfer of knowledge and the building of science and technology cooperation networks.

A particularly important role in building R&D potential is played by business, including transnational corporations (TNCs): on account of their global operations, TNCs are very active in R&D investment, gaining competitive advantages in a competitive international environment . Thus, they become drivers of global R&D, not only due to the amounts spent but also as initiators of R&D internationalisation, building cooperation networks, knowledge and technology transfers and the commercialisation of created knowledge (Karlsson, 2006; Moncada-Paterno-Castello et al., 2011; De Prato and Nepelski, 2013; Zimmermann, 2015).

The current situation of the EU is hardly favourable; although EU-based TNCs rank among firms with the highest R&D investment, the EU is outperformed by East Asia and the USA. The 2500 best-

performing TNCs in terms of R&D expenditure (Top 2500) included 551 enterprises from the EU-28, whereas the respective numbers for the Asian centre and the USA were 984 and 769. However, taking into account R&D expenditure, the US corporations unquestionably led the way with investments of EUR 312.5 billion in 2019. At the same time, TNCs established in the EU-28 spent EUR 208.4 billion, less than East Asian corporations, accounting for EUR 253.3 billion; the Asian centre is led by Japan-based TNCs (European Commission, 2020c, pp. 27–28).

Considering that the position of EU TNCs is much less favourable than those of US and Asian firms, Brexit entails a considerable deterioration in that regard; 127 TNCs from the Top 2500 are headquartered in the UK, i.e. the number of corporations from the EU-27 decreased by 23% to 424 firms and R&D expenditure fell to EUR 179.1 billion (Table 1). Although the strong core of EU-based TNCs includes German businesses (130 TNCs with R&D investment of EUR 82.9 billion) and French companies (68 firms – EUR 30.9 billion), the impact of Brexit is very significant in that field and changes the balance of power in the global R&D system towards the USA–East Asia axis.

Corporate R&D activities are strongly concentrated in specific sectors: in the Top 2500, as much as 76.6% of R&D investment is made in four industries: the automotive industry – 17.2%, health sectors (biotechnology, pharmaceuticals, medical equipment and health care services) – 20.7%, ICT producers – 23.3% and ICT services – 15.4%. In their R&D operations, the EU-based TNCs primarily specialise in the automotive industry, aerospace and defence, whereas the whole ICT industry plays a relatively limited role (with the USA leading the way – 67% in ICT services and 41% in ICT producers – and high performance of East Asia in ICT producers). The contribution of health industries is crucial as well: EU TNCs are behind US firms accounting for 49% of the sector's R&D expenditure in the Top 2500 (European Commission, 2020d, pp. 29–50).

Table 1: EU TNCs' R&D in the Top 2500 by industrial sector

Industrial sector	EU-28			EU-27		
	Number of companies	R&D investments (EUR billion)	R&D in % of the total industry in the Top 2500	Number of companies	R&D investments (EUR billion)	R&D in % of the total industry in the Top 2500
Automobiles	46	64.6	46	40	63.1	45
Health industries	110	45.4	27	78	33.8	20
ICT producers	63	26.9	14	56	25.7	13
ICT services	49	14.8	12	29	11.6	9
Industrials	82	12.1	26	70	11.5	25
Aerospace & Defence	16	9.2	46	10	7.3	37
Chemicals	21	5.2	24	18	4.8	22
Other	164	30.2	29	123	21.4	20
Total	551	208.4	25	424	179.1	22

Source: calculated by the authors based on the European Commission (2020d).

It follows from the data presented in Table 1 that Brexit will bring about the most serious changes in the EU's health industries, with the share of EU-based TNCs in the Top 2500 dropping from 27% do 20%. It results from the fact that the health sector is characterised by significant activities of UK TNCs, third in the world behind US and Swiss corporations. Although the EU's potential is also created by German, French, Irish and Danish TNCs, the EU's diminished role after Brexit is a distinct threat. However, opportunities can be seen in the strong position of the EU's automotive TNCs: the industry will be hardly hit by Brexit. In that sector, EU-based TNCs will maintain their leading position and global attractiveness. In contrast, there will be a marked post-Brexit drop in the share of R&D expenditure in aerospace and defence (from EUR 9.2 billion to EUR 7.3 billion). A mild deterioration will be noted by EU TNCs in ICT, an industry that is not the EU's domain, as already mentioned. It is

also worth adding that in the group of other industries Brexit will involve a loss of the EU's position in sectors such as banking, media and entertainment, dominated globally by TNCs from the UK.

Therefore, it seems justified to rely on the automotive industry, the source of the EU-27's R&D power, in building the potential of EU TNCs after Brexit. It is also desirable to strengthen the health sector to maintain the global attractiveness of EU TNCs. A certain opportunity in that regard is offered by the allocation of EU funds of ca. EUR 1 billion for research related to the coronavirus pandemic in 2020 (European Commission, 2020e).

The future relations between the EU and the UK in R&D policy

The UK largely contributed to the EU's position in research activities, also due to its openness to attracting foreign talents (European Commission, 2020b). As noted by Meulenaer and Veugelers (2019), there are two crucial pathways to excellence: openness to scientific talent and the capacity to engage in research partnerships. In order to maintain its status, the EU must ensure that research mobility and exchanges with the UK should be hampered as little as possible after Brexit.

Scientific cooperation and joint research can be facilitated by various international research programmes established, possibly financed from national funds; undoubtedly, however, the EU programmes create European Value Added, also attracting non-EU countries such as the UK. Further cooperation between the EU and the UK will be beneficial to both parties through shaping scientific excellence, although the very financing from the European Commission, in relation to other external sources, will not be vital to the UK.

To date, the European countries most exchanged in cooperation with the UK have been Denmark, Norway, the Netherlands, Germany, Switzerland; those countries could lose the most to Brexit in terms of research partnerships. As regards the ability to attract talent, the European Research Council (ERC) is another important body for researchers' mobility. The UK attracts talents from the EU, especially from Italy, Germany and Spain; therefore, in this aspect, the countries concerned would also suffer losses due to Brexit should no framework for continued cooperation be established (Meulenaer and Veugelers, 2019).

Although for several decades certain fields of research have been international, recent years have witnessed increasingly globalised and multi-polar networks of scientific and technological entities (European Commission, 2018a). In this context, the EU's policy priority, i.e. keeping up with key competitors in the global R&D system, requires closer cooperation with partner countries, including the UK, to ensure access to world's best talents, expertise and resources in research and innovation (European Commission, 2017b).

In May 2018, the European Commission submitted a proposal for the 2021–2027 Multiannual Financial Framework (MFF), taking into account the result of the 2016 referendum in the UK. However, despite the departure of the UK from the EU, some funds covered by the new MFF will undoubtedly be connected with EU–UK relations. Participation in the EU's future programmes will require the UK's appropriate financial contribution to the EU budget (European Scrutiny Committee, 2018). A likely solution is to apply the mechanism also used for Norway and Iceland (EFTA, 2020), with the financial contributions of those countries calculated on the basis of the GDP of the country concerned relative to the total GDP of the European Economic Area. But it must be stressed that detailed provisions of agreements with the EU vary between countries (Keep, 2019, p. 13). In such a scenario, the UK might become the second-largest payer after Germany. In terms of EU funds received for R&D in 2014–2018, the UK was also the second-largest beneficiary after Germany, but in relative terms (in relation to GDP) the country ranked outside the top ten (Figure 2).

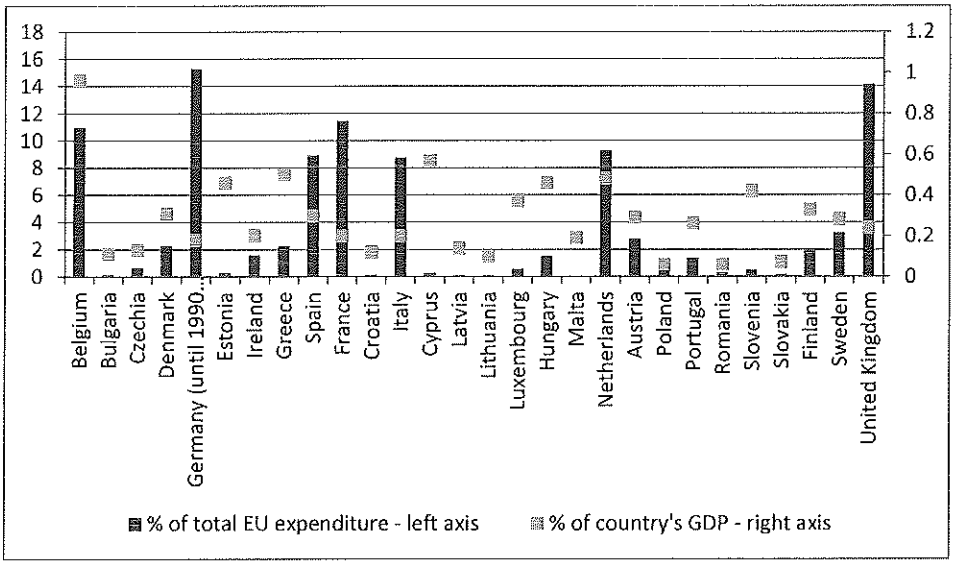

Figure 2: Expenditure on R&D from the EU budget (2014–2018)
Source: prepared by the authors based on Eurostat (2020).

Due to the UK's high research potential, the advantage of improving the quality, scope and critical mass in science and research by combining national and EU funds may be less important than to other countries. As a third country, the UK will be able to collaborate under EU projects, but access to them may be more hindered for procedural considerations, whereas the UK will have no influence on their shape, i.e. the objectives and tasks contained in EU programmes intended to finance R&D. It must also be pointed out that EU measures are increasingly interrelated to produce a synergy effect, i.e. for the results in certain fields to be useful in other areas. In this context, the UK's selective participation in EU programmes may prevent such a synergy effect (Beun and al., 2019). In February 2020, the position of the UK government on the future relations of the UK with the EU emphasised possible participation in several EU programmes, including Horizon Europe (at present: Horizon 2020). In contrast, engagement in the student mobility programme Erasmus+ was indicated as optional and only considered on a time-limited basis (UK Parliament, 2020). As emphasised by Mazzucato (2018), the complexity and specialisation of today's science make openness and cooperation key success factors. In this case, it is difficult to predict whether the UK's being a non-EU country leads to deteriorated arrangements since both parties need one another (Mazzucato, 2018, p. 5).

Indisputable advantages of the joint creation of a European R&D area should not prevent the consideration of the drawbacks of EU funding: multiple sources, i.e. funds and programmes, red tape complications, excessive and non-transparent legislation. Creating a new MFF every few years should be an appropriate solution leading to the implementation of good practices and learning from mistakes, but many programmes and procedures become increasingly complex (cf. Leceta et al., 2017; European Commission, 2017c). Nevertheless, the procedures of the functioning of the EU and its growing focus on innovation and support for research must be appreciated as they go beyond national structures which may hinder scholars through national financing policies (unless private support can be acquired).

It is a rather widespread belief that the EU funding of scientific research brings additional benefits such as (Arnold, 2012; SFIC, 2012; European Union, 2014; European Commission, 2016; European Commission, 2017c, p. 90; Schout and Bevacqua, 2018):

- the creation of EU-wide cooperation networks,
- increasing the geographical scope of research projects,

- project coordination,
- cross-border externalities and the economies of scale,
- improving science and research quality,
- greater research mobility, combining experience and skills,
- the distribution of costs and risks,
- increased access to funding research projects – the pooling of funds,
- more efficient resolution of complex scientific problems,
- influence on national R&D policies,
- coping with global competition,
- efficient use of limited public resources allowing to avoid overlapping and the optimisation of efforts or financial benefits.

However, it is difficult to measure specific benefits due to the lack of sufficient data (European Commission, 2014, 2017c). Nevertheless, the concentration of funds and the above-mentioned advantages of cross-border cooperation in R&D confirm that the beneficiaries create more innovation, whereas the quality of their publications was assessed significantly above the world average (Craciun and Orosz, 2018).

Therefore, it seems that the EU's relationships with the UK are strong enough for representatives of the 27 Member States to recognise the necessity to continue cooperation in research and development to avoid any weakening of the EU and to prevent negative (non-constructive) rivalry between the UK and the EU. The UK is also aware of the need to maintain and develop cooperation with the EU-27 for mutual benefits; therefore, it should be a priority for both parties.

Conclusion

According to the analyses conducted, Brexit has a significant impact on the European Union's R&D potential and poses a major challenge in the context of building the EU-27's position in the global R&D system, with the fast-growing role of East Asia and a strong position of the USA. Any weakening of the EU-27's potential may lead to the creation of a strong East Asia–US axis, characterised by diminishing interest in the EU centre. An important threat is the reduction of human resources in the EU-27's R&D, which may drive down its attractiveness as a cooperation partner for the other two centres and result in weakened capabilities to create new knowledge.

In this context, it is worth pointing out that supporting the potential of EU TNCs could stimulate their participation in global R&D and becoming a transmission channel for the international knowledge transfer and commercialisation as well as for attracting talents. Certainly, an opportunity for the EU-27 is further specialisation in the automotive industry where EU-based TNCs are unquestionably strong. However, measures should be taken to reinforce the potential of the health sector to maintain the EU's role in the global system. The orientation of the EU's research programmes towards health industries might speed up the creation of their potential.

Measures to be taken by the EU-27 to mitigate the consequences of Brexit certainly include the acceleration of and growth in funding within the EU R&D policy, including a focus on improving the efficiency of R&D activities, as postulated in the new financial perspective. Nevertheless, it also seems necessary to mobilise the Member States to increase their spending on R&D and to enhance innovation. Furthermore, it seems crucial to develop R&D cooperation with the other two centres and the UK in order to create global networks and to stimulate knowledge transfer. After all, cooperation and the generation of synergy effects have long been the EU's priorities, whereas its research programmes, attracting non-EU talents as well, represent a strong point in the research policy. Cooperation with the USA and East Asia should be in the spotlight in the EU, especially in industries particularly affected by Brexit (the health sector, the aerospace and defence industry), to rebuild their potential based on global cooperation networks, but it will also be fundamental to maintain cooperation with the UK partners. It seems to be in the UK's best interest as well; however, the UK may seek non-EU-27 partners. It will be of crucial importance to design a mutually beneficial framework for further cooperation in R&D.

Certainly, Brexit is a difficult time for the EU's R&D potential, involving various risks in the above-mentioned aspects; nevertheless, it may also offer an opportunity to re-orient attention and expenditure on R&D, to mobilise the reinforcement of the R&D potential at the EU and Member State levels, to re-define EU policy priorities towards improving the innovation potential and the valorisation of R&D cooperation – today's key to success.

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