Udvari B. – Voszka É. (eds) 2019: Proceedings of the 3rd Central European PhD Workshop on Economic Policy and Crisis Management. University of Szeged, Doctoral School in Economics, Szeged, pp. 155–172.

Considerations on the potential relationship between Regional Competitiveness and Responsible Innovation

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In the 21st century regional competitiveness has become a key concept. Although regarding the definition of regional competitiveness there is no consensus among experts, its main context, influencing factors and methods for measuring it seem to be clear. Among the influencing factors and main drivers, research, development and innovation (RDI) activities play a prominent role. The sources of literature have clearly demonstrated that there is a positive relationship between RDI and competitiveness. However, RDI has more frequently resulted in unintended, negative impacts. To overcome these negative side-effects the notion of Responsible Research and Innovation (RRI) has emerged, which addresses the challenges of the 21st century.

Thus, the question presents itself: how can RRI affect competitiveness? Does RDI have a positive relationship with regional competitiveness if the concept of RRI is applied? The purpose of this study is to trigger thoughts and explore fundamental questions and ideas about the potential relationship between responsible innovation and regional competitiveness. The main aim of improving competitiveness is to maintain long-term prosperity and a high standard of living, and for this purpose responsible innovation could possibly serve as an effective method.

Keywords: responsible innovation, regional competitiveness, RRI

1. Introduction

As a result of the accelerated globalization processes, territorial competition has become even more important than before. On the one hand, technical development (telecommunication, digital technologies) allows us to get in touch with anyone in the world by overcoming geographic constraints, and on the other hand, the limitations of trade and capital flow seem to cease. Thus, it is important to ask: how should companies and territories compete under these changed circumstances? Survival in the global competition, and the crisis in 2008 had a significant impact on the competitiveness of companies and regions. Because of the 21st century globalization tendencies, the economic role of the local space has appreciated (Lengyel 2012, Dicken 2015, McCann 2015). In knowledge-based economies, the role of innovation is unquestionable as the competitive environment requires participants to adapt to the changing environment as quickly as possible. Meanwhile, research, development and innovation (RDI) processes have been undergoing substantial changes, and have had a significant impact on almost every aspect of life. Its positive effects are usually immediately visible to the members of a society, and they contribute to its wellbeing as they promote development.

However, due to these accelerated innovation processes, besides positive effects, innovations have more frequently resulted in unintended, negative impacts, which affect a society, and in particular the welfare of society in a region. To prevent these impacts,

the concept of responsible research and innovation (RRI)[16] emerged. The main objective of responsible RDI processes is to do the best in the present ¬ to improve the standard of living ¬ for the sake of the future by reducing the intended or unintended negative side effects of research and innovations.

Literature sources have long highlighted that RDI has a positive effect on the competitiveness. However, it remains to be seen whether the same tendency is experienced when we apply responsible innovation tools in a region. *The main aim of this research is to explore the interactions between regional competitiveness and responsible innovation.* Regarding the central part of this research, the available literature sources are limited, as few scientific papers have dealt with this topic so far, so my research has significant novelty in this field.

Given that responsible innovation is a relatively new approach, it is difficult to find specific facts about its relationship with regional competitiveness. For this reason, the relationship between the two concepts can be predicted on a theoretical level. *It is important to emphasize that the main purpose of this research is to trigger thoughts about the possible relationship between responsible innovation and regional competitiveness.* Given that we are talking about a complicated relationship, it is difficult to deduce concrete conclusions at the current stage of implementation of responsible innovation.

2. The role of regional competitiveness

Regarding the nurturing of competitiveness and, particularly, territorial competitiveness, there is no consensus, this topic is frequently debated by experts of this field. Due to the challenges of economic life (such as crises), new perceptions and interpretations have emerged from time to time among researchers in the field of competitiveness. In many cases, the debate stems from the existence of competition between the territorial units themselves (Huggins–Thompson 2017, Lengyel 2012, Lengyel 2016a).

Krugman argues that competitiveness can only be interpreted among companies, and not at the level of countries or regions (Krugman 1994). Krugman's views have been confirmed by some experts, while others point out that competition between territorial units (countries, regions) can be also observed, but it differs from the competition experienced between companies (Camagni 2002, Gardiner et al. 2004). If we accept that territorial units also compete with each other in striving for a better position, then competitiveness can be interpreted at the level of companies, industries, regions and nations too (Chikán–Czakó 2009). Several approaches have come into being for defining competitiveness (Camagni 2002, Gardiner et al. 2004, Lukovics 2008, Lengyel 2012, Huggins el al. 2013). Among the various interpretations, the following concept of competitiveness has become widely recognized: *"The ability of companies, industries, regions, nations and supra-national regions to generate, while being exposed to international competition, relatively high income and employment levels"* (EC 1999, p. 75, Lengyel 2000, p. 974).

[16] Although most sources use the term Responsible Research and Innovation (RRI), for the sake of simplicity, in this study, we use the notion of responsible innovation, but it refers to research and development activities as well.

However, after the crisis in 2008, it has become an accepted view that the role of GDP is over-emphasized in measuring economic growth and competitiveness, and the role of social welfare and well-being have become more dominant in place of GDP (Stiglitz et al. 2010, Aiginger–Firgo 2015). As a result, the concept of competitiveness has been redefined in many cases.

Meanwhile social prosperity and sustainable development have been incorporated into the concept of competitiveness (Lengyel 2016b). Thanks to this, a new interpretation of regional competitiveness has emerged: *„place-based economic growth, which is the result of improved labour productivity and a high level of employment and which contributes to the prosperity and the standard of living of the inhabitants of the region"* (Lengyel 2016b, p. 74). This research is also based on this definition. During this study, competitiveness and territorial competitiveness always refer to the competitiveness of territorial units.

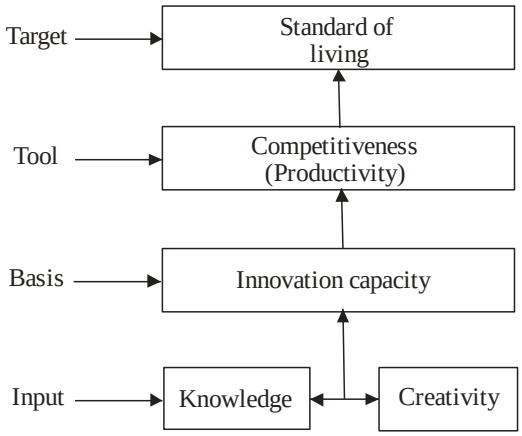
3. The relationship between innovation and competitiveness

It has become clear that innovation plays a significant role in improving the competitiveness of companies and regions. As innovation activity is part of complex competitiveness indices, it is important to gain a deeper insight into the characteristics of the direct relationship between competitiveness and innovation to serve as a basis for thoughts about the possible relationship between RRI and competitiveness.

3.1 Interactions of innovation and competitiveness

Innovation performance is the key to competitiveness and national development (OECD 2007). There is a positive relationship between innovation and competitiveness, as in order to maintain a high level of performance and competitiveness, innovation is necessary (Bayarcelik–Taşel 2012, Huang 2011, Petrakis et al. 2015). In economies with globally competitive companies, the road to competitiveness can be achieved through innovation (Ciocanel–Pavelescu 2015). Moreover, the standard of living of a region is largely determined by the productivity of the economy (Porter 2001). According to Porter (2001), productivity itself is not enough to improve competitiveness and the standard of living in a region. Developed regions need innovation to be able to produce products and services that can help them to maintain the benefit of their productivity that can result in higher wages. For the creation of innovation, both knowledge and creativity are needed. However, these are not enough in themselves for innovation, as the combination of them is necessary to create innovations that can increase competitiveness (Figure 1).

Figure 1 The logical structure of knowledge-based economic development

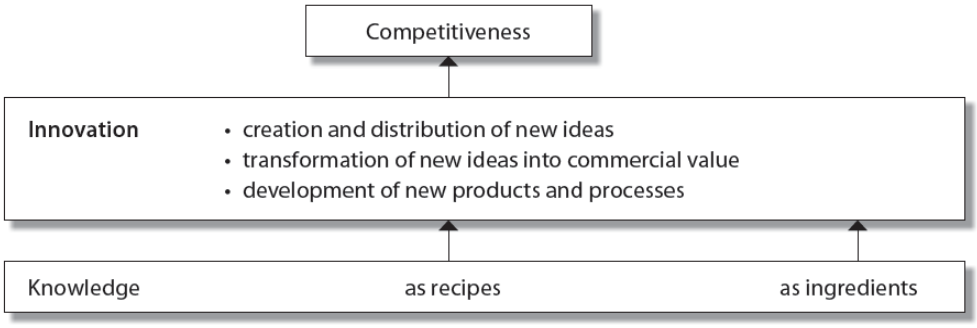


Source: Rittgasszer–Lukovics (2012, p. 221)

Innovation enables companies to adapt quickly to the pace of technological change to boost their competitiveness (Ciocanel–Pavelescu 2015). The relationship between innovation and competitiveness is correlated, as the competitive environment also influences the innovation process (Bayarcelik–Taşel 2012).

Over the last few years, many literatures have investigated the relationship between RDI and competitiveness (Ciocanel–Pavelescu 2015, Gocer 2013, Gulmez et al. 2012, Tiryakioglu 2006). Ciocanel and Pavelescu (2015) highlighted that RDI expenditures can play a significant role in increasing competitiveness. They examined the impact of innovation on competitiveness in analysing the competitiveness of 29 European countries, and their research confirmed that the "innovation paradigm" is sustainable, and innovation can improve competitiveness. Effective and successful application of existing technologies can therefore be a crucial tool for maintaining economic growth and development (Huggins Thompson 2015). Huggins et al. (2013) emphasized that knowledge, innovation and competitiveness are closely related concepts: knowledge is the building block of innovation, while innovation contributes significantly to increasing competitiveness (Figure 2).

Figure 2 The relationship between knowledge, innovation and competitiveness

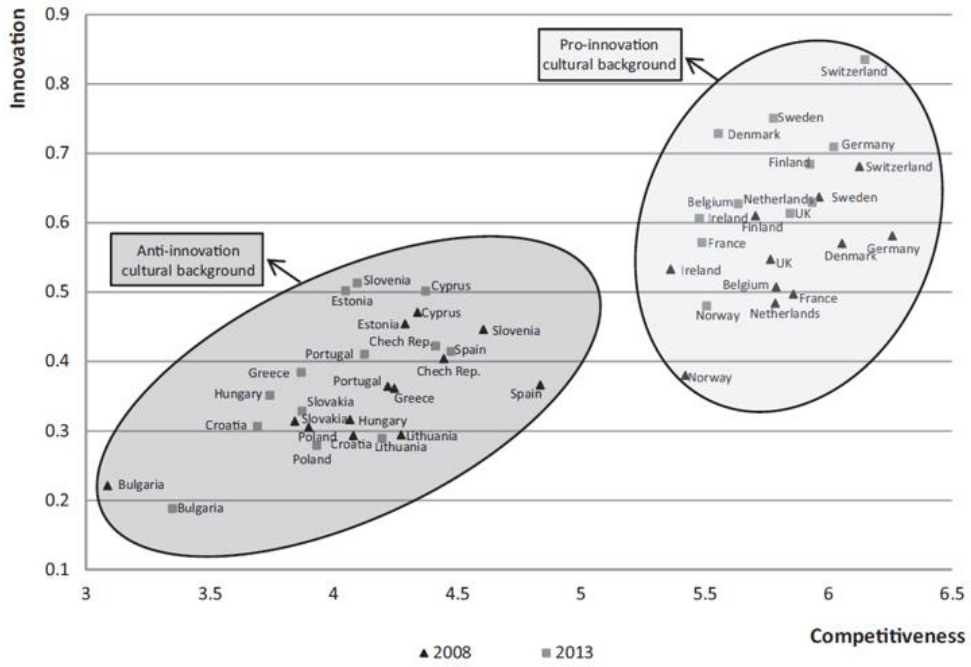


Source: Huggins et al. (2013, p. 159)

It is important for a country and a region to have competitive companies in order to be in a competitive position. The competitiveness of a company in the long term can be determined by technological advances and the ability to learn and innovate (Bernard et al. 2007). Innovation is significant in maintaining competitiveness on the long term, as the competitiveness of a country or region is increasingly determined by what kind of advanced technology is available within the region and the extent to which the regions are able to develop and apply these dominant technologies (Lengyel 2010).

Innovation and competitiveness depend directly on macro-level conditions too (Bayarcelik–Taşel 2012). At the national level, innovation can make a significant contribution to the development of the economy and can also speed up recovery from crises (Hausman–Johnston 2014). Culture is an integral part of innovation and it involves the acquisition and development of new ideas. Cultures that reward creativity and encourage people to reach their individual goals generally achieve better results in terms of innovation and their competitiveness can be improved too (Petrakis 2014). Petrakis et al. (2015) investigated the performance of 24 European countries during the Great Recession of 2008–2013. Their research shows how innovation and competitiveness performance is related to cultural background factors (Figure 3.).

Figure 3 Innovation and competitiveness in European countries (2008–2013)



Source: Petrakis et al. (2015)

In their study, they point out that an innovation-friendly environment enhances competitiveness even if macro conditions are not the most appropriate. Furthermore, if the society has an anti-innovation culture, the existence of the appropriate macro conditions will not lead to greater competitiveness.

3.2. The emergence of innovation in competitiveness indices

At the global level, as well as in the European Union, measuring competition between the various regions has a long history. From the different competitiveness reports it becomes clear that there are some relationships between competitiveness and innovation, as innovation capacity and innovation activity are part of the complex competitiveness indices, so we have to take a deeper look at the direct link between competitiveness and innovation. The most frequently used competitiveness reports are:

1. The IMD World Competitiveness Yearbook (WCY) which annually reviews and prioritises countries on how to manage their competencies for long-term value creation (IMD 2017a).
2. IMD established a new ranking in 2017, the World Digital Competitiveness Ranking. The rankings reveal the capabilities of countries that are needed to develop and apply digital technologies that transform government practices, business models and society in general (IMD 2017b).
3. The Global Competitiveness Index (GCI), which is published annually by the World Economic Forum, WEF (WEF 2016). It emphasizes the growing role of innovation and technological development, that can mostly be attributed to the Industrial Revolution 4.0.
4. Besides the indices and rankings that measure the competitiveness of countries, some indices have been developed that analyse competitiveness at the level of smaller territorial units and regions. We have also included in the analysis the Regional Competitiveness Index (RCI), that was created with the aim of measuring regional competitiveness (EC 2017a). RCI provides a European perspective on the competitiveness of all NUTS-2 regions in the EU.

The common features of these indices and rankings is that all of them regard innovation as a key factor for realizing competitiveness. In most of the rankings, the role of innovation is highlighted as being a separate sub-index. The rankings take into account the legal regulation of scientific research that promotes innovative activities. The protection of intellectual property rights and the quality of scientific infrastructure are also important aspects, and they assess the technological and economic value of patented inventions and the possible effects on technological development too. Furthermore, knowledge transfer between universities and business as one of the basic prerequisites for innovation can have a significant impact on the role of a given region in competition. WEF GCI puts emphasis on promoting creativity, assessing new ideas and assessing the proportion of risky and disruptive innovations. In the case of IMD WCY, the role of scientific research is also significant, and among the indicators there are factors that contribute to the attractiveness of a given region to researchers and scientists. The IMD Digital Competitiveness Ranking focuses on the role of the regulatory framework with regard to technology, which is an important factor in stimulating and facilitating the development of innovation. Preparations for the future also serve as a separate factor, as change in action affects the successful application of innovative ideas.

To sum up, the ability to innovate can increase the competitiveness of an area and thus play a significant role in increasing the standard of living of people living there. In general, innovation plays a major role in improving the competitiveness of regions, but the important question remains, of whether taking into consideration the notion of responsible innovation can result in similar tendencies?

4. Responsible innovation

Today, it has become obvious that global challenges (such as the depletion of the ozone layer, population growth) must be answered as fast as possible. The main question is no longer whether innovation is needed, but the question is more about how to conduct innovation that can help to adapt to the changing environment (Inzelt–Csonka 2014). The key role of innovation is to find solutions to the great challenges of the 21st century as fast as possible. Innovation is necessarily accompanied by unpredictable risks and uncertainties that may have a negative impact in the long term (Buzás–Lukovics 2015). Avoiding uncertain future events and possible negative consequences has given rise to one of the most significant recent scientific and practical approaches, the Responsible Research and Innovation (RRI). The guiding assumption of the concept is that research, development and innovation already include certain ethical and social aspects (Lukovics et al. 2017). This can help RDI participants to cope with the uncertainty and complexity associated with innovation (Lukovics et al. 2017). A new approach to innovation has emerged, but it does not mean that innovation has been irresponsible to date, but stresses that the negative effects of innovation on individuals, society and the environment have not been taken into account, as economic growth or profitability were more important (Blok–Lemmens 2015). Responsibility can be interpreted as an extension of the concept of innovation, where innovation is regarded as an integral part of innovation and stakeholder involvement while also taking into account ethical and social aspects (Blok–Lemmens 2015). Thanks to this extension, innovation processes may be able to find a balance between economic profit, social interests and environmental interests (Blok–Lemmens 2015).

The main aim of responsible innovation is to create innovations that contribute to the improvement of the standard of living of society while reducing the potential negative impacts of research and innovation. In the past few years several definitions of RRI has been offered for defining the concept (Owen et al. 2012, Sutcliffe 2013, Buzás–Lukovics 2015). However, the scientific community and the European Union most frequently rely on the definition of von Schomberg (2013, 60.): *"A transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)".* Accordingly, innovation can be responsible if it takes into account the social, environmental and ethical considerations during innovation processes, and if it is based on social needs and the involvement of the widest possible range of stakeholders from the earliest stage of the research (Forsberg et al. 2015). The 'Science with and for Society' slogan well illustrates that responsible innovation places great emphasis

on co-operation among the stakeholders involved in the innovation process (Fisher et al. 2006). As the theoretical background of the concept seems to be clear, the next challenge is to implement the concept into practice. In order to make implementation simpler and more comprehensible to the public, the European Commission has introduced six key elements (RRI keys) that can serve as a framework for attracting research and innovation (2014): public engagement, science education, governance, open access, ethics and gender equality. In addition, responsible innovation is characterized by transparency, interaction and mutual responsibility. These are the key factors for more effective cooperation and communication among stakeholders (Schomberg 2013, Sutcliffe 2013).

Pavie et al. (2014) highlighted that responsible innovation is a strategy for integrating responsible thinking at all stages of RDI processes. The main task of actors involved in innovation processes is to take into account potential social, environmental and ethical impacts, and if these effects appear to be negative, they should intervene and minimize the potential dangers. Responsible innovation builds on this fact and tries to increase the knowledge base and awareness to improve responsibility in decision making.

In RRI related studies from the business sector, the social responsibility of companies appears in several international publications (Gurzawska et al. 2017, Iatridis–Schroeder 2016, Pelle–Reber 2015). Many companies realised that they are responsible for society and the environment and most of the large companies have their own CSR strategies (Gurzawska et al. 2017). *The Corporate Social Responsibility (CSR) is a central issue for the practical implementation of RRI* (Pelle–Reber 2015). According to the European Commission CSR is "the responsibility of enterprises for their impacts on society" (EC 2011, 6.). *The concept of CSR can help to further develop the concept of RRI, providing a theoretical framework and practical standards (standards and principles of responsibility) for managing innovation* (Iatridis–Schroeder 2016).

However, Gurzawska et al. (2017) highlighted that responsible research and innovation and CSR show many differences, yet they are based on many similar principles. On the one hand the two concepts are quite similar in many aspects. Both concepts emphasise the companies' social responsibility and stakeholder engagement. Both CSR and RRI strategies are usually the results of a broad, multi-step consultation process with the involvement of different stakeholders (Pavie et al. 2014). CSR also regards stakeholder engagement as the main resource of profitability (Freeman 1984).

5. The possible relationship between responsible innovation and regional competitiveness

As a result of the main findings of the relationship between innovation and competitiveness, the question remains: if innovation has a positive impact on the competitiveness of a region, does it mean that the same tendency can be observed in the case of responsible innovation.

5.1. The impact of responsible innovation on regional competitiveness

The assumption of responsible innovation is that innovations are inherently good as they create prosperity and jobs and at the same time take into consideration societal challenges (von Schomberg 2013). However, research and innovation do not automatically lead to socially desirable and ethically acceptable profit combinations, social prosperity and environmental sustainability (de Hoop et al. 2016). Indeed, this assumption has been questioned in recent years, so responsible innovation came into being as a new approach for managing innovations.

Zadek et al. (2005b) pointed out that unmanaged economic growth itself is not capable of creating sustainable development. This requires a more responsible form of competitiveness, which is indispensable for achieving sustainable development in a globalized world. Disadvantages that go hand in hand with economic success (for example, contamination of the environment) have made more and more business leaders realize that they have to do business in a different, more responsible way for sustainability. As a result, businesses increasingly recognize the importance of their role in society (Fussler et al. 2004). The responsible vision and practice of globalization is widely acknowledged (Zadek 2006). However, the "invisible hand" of the market creates its own movement and direction, and the negative, often irreversible effects of global competition are not easily prevented (Zadek 2006). Although some companies take into account social and environmental risks, mostly the main objective is short-term profitability, and in this case these factors are negligible (Zadek et al. 2005a). The main challenge is thus to create a responsible concept for competitiveness (Zadek 2005a), where responsible innovation can be of paramount importance.

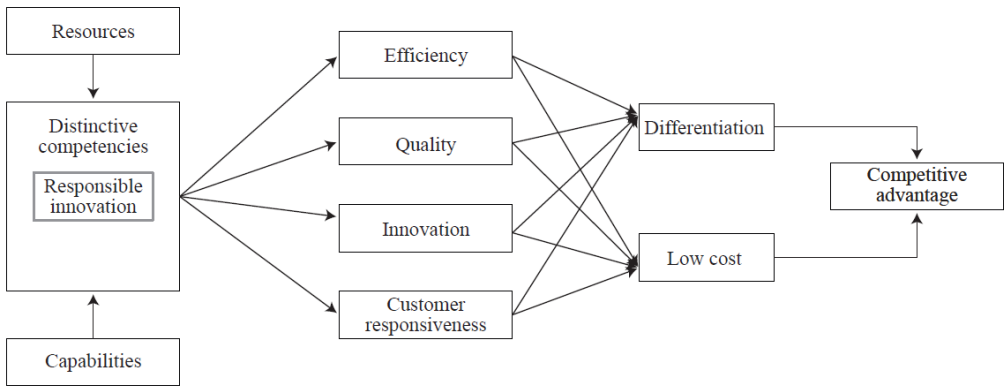
Researches have shown that partnerships with stakeholders can play a significant role in the innovation process. Innovation can be successful in an open innovation environment, as cooperation and interaction with different stakeholders can be a source of competitive advantage (Chesbrough 2003). Multi-stakeholder partnerships can result in innovative and responsible solutions (Blok–Lemmens 2015). As we mentioned previously, one of the key features of responsible innovation is transparency. However, according to some interpretations, the requirement for transparency in innovation processes is a naive concept (Blok–Lemmens 2015). Innovation is the main competitive advantage for a company, which advantage is based on the information asymmetries. This information may provide possibilities that can provide new or alternative solutions for existing or anticipated problems, thus information asymmetries should be regarded as a potential source of competitive advantage. In the context of responsible innovation, cooperation with stakeholders is expected, but in some cases particularly in the context of intellectual property and business secrecy, this cooperation is being reduced to maintain a competitive advantage (Flipse 2012).

Scholten and Van der Duin (2015) noted that taking into account RRI considerations could create a favourable environment for the development and improvement of competitive advantage, as consumers and stakeholders are more willing to cooperate with companies that are sustainable, ethical and associated with socially desirable production systems and products. Due to such cooperation, it is possible that stakeholders and consumers could apportion more value to the company's

products. According to Zadek (2006) if a business is reliable and socially accepted, it can provide greater possibilities to improve and maintain competitiveness. Based on this, responsible innovation can be a valuable source of competitive advantage (Lees–Lees 2017).

According to the resource-based view, competitive advantages derive from two main components of strategic capabilities: these are the capabilities and the resources (Johnson et al. 2008). Resources are the assets that the company owns, controls and uses for the purpose of creating value (Johnson et al. 2008). Responsible innovation can lead to valuable intangible resources such as brand value, reputation, or good relationships with stakeholders. Responsible innovation can thus be interpreted as a distinctive competency that consists of a unique combination of resources and abilities (Figure 5). To achieve competitive advantages, it is necessary to build on distinctive competences that will be implemented in terms of efficiency, quality, innovation and customer needs (Lees–Lees 2017). Recently some changes have been observed in innovation processes. By taking into consideration the social, ethical and environmental impacts of innovation, we can raise responsible innovation to a distinctive competency that can be a significant competitive advantage for a company or region.

Figure 5 The basis of competitive advantage



Source: Lees and Lees (2017)

This subchapter highlighted the importance of responsible innovation concerning its impact on competitiveness and the standard of living of a society. The following subchapter will detail the role of RRI and its elements, as well as key features in the different competitiveness indices and rankings.

5.2. The impact of responsible innovation on competitiveness in the light of competitiveness indices

We have already confirmed that innovation plays a significant role in the improvement of competitiveness, so it is worth examining the impact of RRI in competitiveness reports and rankings. In fact, we found that there is a kind of

transition in competitiveness indices and rankings that has already included the distinctive features of responsible innovation (Table 1).

The IMD Competitiveness Yearbook measures transparency, which is a key factor of RRI, however this indicator does not refer to research but to government transparency. Gender equality also appears among the indicators, but the ratio of female graduates, and not the ratio of female researchers is examined by the indicator. Corporate social responsibility can include social, environmental and ethical aspects. Scientific education, as one of the key elements of responsible innovation, is also an important aspect that contributes to the improvement of competitiveness.

Indicators of the IMD World Digital Competitiveness Ranking include scientific education, which measures the proportion of graduates in the natural sciences. Gender equality appears in the ranking as well, as a factor influencing digital competitiveness, by assessing the proportion of female researchers. The involvement of stakeholders also appears at a certain level in the field of cooperation between companies and universities. In addition, co-operation between the private and public sectors is also reflected in the indicators of technological development.

The WEF Global Competitiveness Index highlights the involvement of society as a crucial factor in improving competitiveness. For development we need to create an environment that fosters innovative activities, supported by both the public and the private sector. This means both appropriate RDI investments and the existence of high-quality scientific research institutes capable of producing the basic knowledge needed to build new technologies. Therefore, extensive cooperation between universities and industry is important in research and technological development. In addition, ethics as a key element of responsible innovation, also plays a key role in increasing competitiveness. GCI characterizes health and education as a factor affecting competitiveness. In terms of responsible innovation, these factors may appear indirectly as the role of innovation in the healthcare / pharmaceutical industry is significant, and there are serious ethical problems in this area, which already has an RRI focus. Furthermore, the role of education is significant in creating new RDI results. The education factor includes the quality of academic education, which is also one of the six key elements.

The Regional Competitiveness Index also addresses ethical and social aspects of competitiveness. Thus, ethical considerations also play a central role in improving competitiveness. Among the key elements of RRI, ethics, science education, and gender equality are among the indicators. The latter appears indirectly: it assesses gender equality in the field of higher education and measures the proportion of employed and unemployed women. By contrast, in terms of RRI, gender equality refers to the proportion of female researchers. RCI is different from the previous two competitiveness reports as the environmental factors do not appear as competitive advantages. The number of scientific publications is also one of the factors that improve competitiveness. If these publications are open to anyone, they can be interpreted as a key element of RRI, providing open access.

Table 1 The key aspects of responsible innovation in the competitiveness indices

	RRI keys	Direct aspects	Indirect aspects
IMD World Competitiveness Yearbook	Science education		Transparency Gender equality
IMD World Digital Competitiveness Ranking	Science education Stakeholder engagement Gender equality		
Global Competitiveness Index	Ethics Science education Stakeholder engagement	The degree of risky ideas Scientific Publications	Health Education RDI investments Existence of high-quality scientific and research institutions
Regional Competitiveness Index	Ethics Science education Stakeholder engagement	Scientific publications	Gender equality

Source: Own construction based on IMD (2017a), IMD (2017b), WEF (2016), EC (2017a)

In the three competitiveness reports reviewed, besides innovation, the key aspects of responsible innovation are also emphasized. In addition, at least three of the six RRI key elements, including ethics, science education, and stakeholder engagement are part of the indicators that contribute to the improvement of competitiveness. It is presumed that these elements should be taken into account as elements of responsible innovation.

6. Main findings

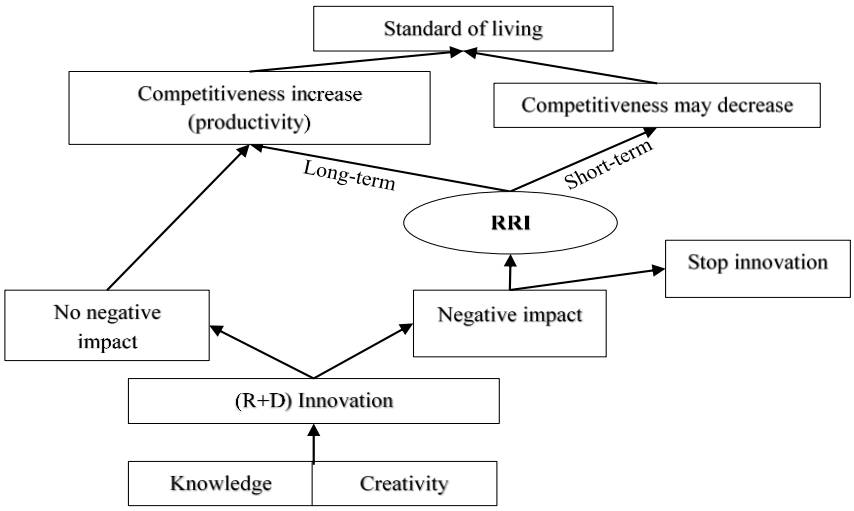
Literature sources have pointed out that a more responsible form of competitiveness is needed, thus more and more businesses perceive that they have to innovate in a different, more responsible ways. Those who do not take into account social and environmental concerns are mostly focused on short-term profit. Cooperation with members of society (stakeholders) is of particular importance, which can be the source of competitive advantage, these partnerships making it possible to create innovative and responsible solutions.

In addition, taking into account RRI considerations can create a favourable environment for the development and improvement of competitive advantage, as consumers and stakeholders are more willing to cooperate with companies that are sustainable, ethical and socially desirable. Reliable, socially-accepted RDI promotes competitiveness, so responsible innovation can be a valuable source of competitive advantage. By considering social, ethical and environmental impacts, RRI can become a distinctive competency that can be a significant competitive advantage for a company or region. Moreover, considering the different competitiveness indicators, we can conclude that there is a kind of transition to competitiveness indicators and rankings which already has the distinctive features of responsible innovation. Particularly

stakeholder involvement, ethics and science education appear as factors that can improve competitiveness.

Knowledge and creativity are essential for new ideas and thus innovation. However, at almost every phase of research, development and innovation, doubts about possible negative impacts may arise. Thus, for scientists and innovators who think responsibly, it is necessary to assess whether any negative impacts on the environment or society may arise. If the researcher realises that innovation can have a negative impact, then the concept of RRI emerge. In this case researchers may decide to stop the innovation process or to continue it, taking into account the interests of the different stakeholders, but also by examining the effects of the RRI on environmental, social and ethical considerations. The latter not only takes much time and energy, but it also costs more, so it is likely to reduce competitiveness in the short term. However, it may be profitable in the long run if a product / service is placed on the market that is ethical, environmentally and socially useful and thus socially accepted (Figure 5).

Figure 5 The logical structure of knowledge-based economic development in the light of RRI



Source: own construction based on Rittgasszer and Lukovics (2012)

During this research, some questions and possible limitations have arisen that suggest that the results of this research should be treated with reservation. The first question that arises in investigating the central issue of this research is how to measure competitiveness. There are countless reports and rankings to assess the competitiveness of regions. Though most of them make their final analyses with similar indicators, they apply very different methods, which may also have an impact on the results. This raises the question of the kind of indicators that should be involved in the analysis, and what kind of methodology should be used if we want to examine the competitiveness of an area? Considering these issues is a key point in terms of competitiveness, as even changing an indicator may also show discrepancies in the

outcome. Moreover, competitiveness is a rather complex phenomenon, with more indicators that can influence the results, so it is not possible to grasp a single element and consider its impact on competitiveness. It is worth considering all the indicators as a whole, instead of dividing them into their elements, since competitiveness cannot be interpreted as the sum of each element. Responsible innovation is a relatively new phenomenon. It has a decade-long history, and therefore it is difficult to predict what its effects in the future will be, and whether it has any added value to competitiveness compared to innovation. The application of responsible innovation is not widespread so far, so my research can be interpreted mostly at a theoretical level. To sum up, I would like to draw attention to the fact that, although we can draw the conclusion that the relationship between responsible innovation and regional competitiveness seems to be rather positive with regard to the main research results it is worth taking the results with the utmost caution.

7. Conclusion

In this study, we examined the interactions between regional competitiveness and responsible innovation. *The main purpose of our research was to trigger thoughts about the possible relationship between responsible innovation and regional competitiveness.* The background of our research derives from the fact that responsible research and innovation is becoming more and more common and widespread in the world. The literature sources highlighted that innovation has a fundamentally positive impact on the competitiveness of a region, but the question arises whether such impacts are evident in the case of responsible innovation too? Based on our preliminary assumptions, if innovation contributes significantly to the competitiveness of a region through the improvement of the standards of living of the people living there, we will experience this effect in the case of responsible innovation too.

The main conclusion to be drawn in this research is that supposedly responsible innovation can have a positive impact on the welfare of people in a region. Considering the main aspects of responsible innovation (environmental, social and ethical), RRI can make a significant contribution to the improvement of competitive advantages, as both consumers and stakeholders are more willing to cooperate with companies that are sustainable, ethical and socially desirable. Furthermore, stakeholder involvement can also make a significant contribution to the development of competitive advantages. It is important to mention that some types of indices and rankings used to measure and capture competitiveness also show that some elements and dimensions of RRI are already integral parts of these indices.

The results of the research raised further questions that we shall no doubt answer in the future. Given that we are talking about a complex relationship, it is difficult to deduct concrete conclusions at the current stage of the implementation of responsible innovation, and it puts a serious constraint on research. *The main purpose of this research was to trigger thoughts about the possible interactions between responsible innovation and regional competitiveness.* In the future, further research could be carried out with the aim of exploring more specific and concrete relationships between the two notions. In conclusion, the issues raised may create an appropriate basis for further research to explore the relationship between responsible innovation and regional competitiveness.

Acknowledgments: Supported By the UNKP-17-2 New National Excellence Program of the Ministry of Human Capacities

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