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. 125–137.

Role and contribution of different university models in designing and implementing smart specialization strategies

János Gyurkovics

Building on unique regional strengths, smart specialization focuses on fostering learning linkages within and between regions to facilitate the evolution of new activities, industries and to develop new growth paths. However, a mismatch between the demand for and supply of skills and knowledge in the local economy has often been observed which inhibits knowledge flows, the diffusion of new ideas, applications and the evolution of new technologies. Therefore, a proper matching between investments in knowledge and human capital and the present state of industrial development in the regions is required.

In this process universities may play a crucial part as key knowledge-producing institutions and central players of regional knowledge networks. However, different university models, because of their varying objectives, roles and levels of engagement, might contribute to the success of smart specialization strategies in very different ways. So, in this paper I identify the potential role and contribution of different university models in designing and implementing smart specialization strategies.

Keywords: university, smart specialization strategies, S3

1. Introduction

Universities are often perceived to play an important role in innovation processes and economic development of their regions. Thus, policy-makers around the world are increasingly urging them to become more valuable assets to their surrounding areas, and many policy documents deal with their potential role and contribution to regional development. This notion has also been integrated into the recently emerging research and innovation policies which have adopted the concept of smart specialization as a fundamental principle. Actually, smart specialization means a new way of thinking about and designing policy which involves the largest possible number of stakeholders to identify unique strengths in their region, upon which regional policy might be built. The aim of smart specialization strategies, based on regional strengths and opportunities, is to foster learning linkages within and between regions to facilitate the evolution of new activities, industries and to develop new growth paths.

However, different university models that coexist at the same time might contribute to the success of smart specialization strategies in very different ways because of their varying objectives, roles and levels of engagement. So, in this paper I try to identify the *potential role and contribution of different university models in designing and implementing smart specialization strategies.*

In the following sections I briefly introduce the concept of smart specialization, then sketch the main features of the five university models and finally, I try to identify their possible contribution and linkages to smart specialization strategies in three different dimensions.

2. Smart specialization: from sectoral to spatial approach

Reading scientific articles or policy documents, prepared in the past few years in connection with economic development and growth in Europe, one frequently comes across the concept of *smart specialization*. It has become a widespread buzzword since the Europe 2020 Strategy and its Innovation Union Flagship Initiative adapted the concept (CEC 2010). Further emphasis was placed on smart specialization when the preparation of National and/or Regional Research and Innovation Strategies for Smart Specialization were stipulated as ex-ante condition for the granting mechanism of European Regional Development Funds in the 2014–2020 programming period. All in all, this concept and its underlying theories has determined and influenced regional policies, research and innovation processes in the European Union between 2014 and 2020, so a deeper understanding of smart specialization might be essential.

The appearance of the smart specialization concept could have its origins in the decreasing share of R&D investment in Europe along with an increase in R&D investments in Asia and the US (Foray–van Ark 2007). The authors identified two main barriers that hinder the attraction of R&D investment in Europe: (1) fragmented and uncoordinated national science and technology policies which hamper the natural evolution of European centers of excellence (e.g. agglomeration of highly skilled human workforce, talents, ideas, developed infrastructure and other related services of some scientific field) by supporting a wide range of scientific areas instead of focusing on a merely a few; (2) overemphasizing one or two 'popular' fields of science (e.g. biotechnology, ICT) which leads to the uniformity of countries in terms of R&D and the neglecting of their endogenous strengths. To overcome these problems in R&D investments and to put Europe back in the global game of R&D, Foray and van Ark (2007) introduced smart specialization, which facilitates a European-wide specialization in different scientific fields. The original aim of smart specialization was twofold: facilitate unrestricted evolution of European centers of excellence and support a relatively balanced distribution of research capacities and capabilities across Europe (McCann–Ortega-Argilés 2011).

In their later work (Foray et al. 2009), they have shifted away from the strong R&D approach to the promotion of technological diversification and specialization in national economies (McCann–Ortega-Argilés 2011). They argue that policy-makers should encourage programs supporting the expansion of actual industrial facilities in the respective country to create comparative advantages (Foray et al. 2009). However, programs based on smart specialization should not be conceived of as top-down interventions, but rather as bottom-up methods where the *entrepreneurial process of discovery* is the main driving force. This process is understood as an identification process during which *entrepreneurs and other actors within their domain reveal and define smart specialization opportunities* that draw on existing assets and strengths on which (innovation) policies are meant to focus (McCann–Ortega-Argilés 2011). These smart specialization opportunities are described as exploitation, dissemination and adaptation of the so-called *general purpose technologies* (GPTs) in a particular domain.

Originally the fundamental idea of smart specialization was developed on a sectoral base. But in recent years *the term 'domain' has begun to be interpreted as region*, which has induced the spatial extension of smart specialization (McCann –

Ortega-Argilés 2011). This spatial extension was also underpinned by the "Barca Report" which has emphasized the necessity of place-based policy-making. Applying smart specialization in a regional policy context has led to changes in the phenomenon. In a spatial approach the entrepreneurial process of discovery focuses on the identification of science and technology areas (sectors) with distinctive market potential in a particular region to facilitate regional development and growth (Kempton et al. 2013). The actors of this process, based on their experience in the local economy, identify regionally prominent sectors among which knowledge could be transferred and spill-overs could be incurred in order to develop new growth paths. However, the objective is not to stimulate these sectors per se but to enhance interaction between different but related activities (Boschma–Gianelle 2014).

One of the key issues here is *embeddedness*, because these sectors have to be well embedded in the regional economy, in the regional industrial environment, otherwise the success of this specialized diversification policy may be less likely and the expected local impacts may not occur (McCann–Ortega-Argilés 2011). Furthermore, the size of these sectors should also be taken into consideration because they have to be large enough to generate significant benefits from knowledge spill-overs for the local economy. Another determining issue is *relatedness*. As Boschma and Gianelle (2014) claim, related variety within a region might facilitate the useful recombination of knowledge assets (GPTs included) by allowing knowledge to spill over between different but technologically related industries. In a regional context, it could be said that the higher the degree of relatedness in a region, the more learning opportunities are present, and the more it could contribute to regional growth (Frenken et al. 2007). Moreover, the higher the number of technologically related industries in a region, the more likely the actual industrial environment will expand in a sustainable way, because new industries will more probably be connected to existing ones (Neffke et al. 2011). However, unrelated diversification might be responsible for better regional resistance to external shocks; hence it might secure long-term regional development (Boschma–Gianelle 2014, Frenken et al. 2007) but the focus of smart specialization strategies is rather medium-term.

Finally, valuable sources of knowledge may also arrive from other regions, so the *connectedness* – or *connectivity* as proposed by McCann and Ortega-Argilés (2011) – of the domain (the region) is the third key element of smart specialization. Regions well connected with other regions have greater possibilities for learning and growth since the inflow of new knowledge may help to avoid negative regional lock-in and may facilitate the diversification of the regional industrial portfolio (Boschma–Iammarino 2009, McCann–Ortega-Argilés 2011). Naturally, the positive effects only occur if the extra-regional knowledge stems from related and not identical industries to the regional ones. Hence, making connections between technologically related activities within and across regions is equally important in order to fully exploit the potential of a region (Boschma–Gianelle 2014).

If we take a closer look at the abovementioned phenomena we notice that they are *well in line with the 'local buzz, global pipelines' theory* (Bathelt et al. 2004). While embeddedness and relatedness may be mainly responsible for a well-functioning local buzz, by making it possible for regional actors to interact and knowledge to flow unrestrictedly between them, connectivity may be related to the

creation of global pipelines and responsible for the acquisition of new ideas, competencies and knowledge.

All in all, smart specialization is a local knowledge and learning enhancement concept with the aim of fostering learning linkages within and between regions to facilitate the evolution of new activities, industries and to develop new, unique growth paths (McCann–Ortega-Argilés 2011). It proposes a new innovation policy design which involves different actors in the process of entrepreneurial discovery (Kempton et al. 2013). However, entrepreneurs have to be defined in a broader sense. Private and public organizations should also be involved in the process because the 'right' knowledge to design and implement regional smart specialization strategies does not exclusively stem from market-oriented organizations (Boschma–Gianelle 2014). In the following sections I will focus on the potential role and contribution of one particular type of organization – universities – in developing and implementing smart specialization strategies, since because of their nature, they are expected to have a prominent role in the process.

3. University models and economic development

According to the proponents of the smart specialization concept, one of the problems that many European regions have to face is the weak correlation between R&D, training specialization and the structure of local and regional activities (McCann–Ortega-Argilés 2011). There is often a mismatch between the demand for and supply of skills and knowledge in the local economy which can negatively influence the economic development and innovation potential of regions. Furthermore, the weak relationship between regional actors and the potentially large gaps between their knowledge bases can inhibit knowledge flows, the diffusion of new ideas, applications and the evolution of new technologies in local industry (McCann–Ortega-Argilés 2011). Therefore, *possible regional innovation policy aims* could involve fostering the proper matching between investments in knowledge and human capital and the present industrial and technological set-up of the regions (Camagni–Capello 2012), and furthermore, to facilitate the formation of learning networks. In these processes universities may play a crucial part as key knowledge-producing institutions and central players of regional knowledge networks, but their direct contribution to the formation of regional policies should also not be overlooked. Thus, a better understanding of their role in light of the smart specialization concept could be quite a relevant topic.

In general, the role and contribution of universities to the development of regional economies (and regional smart specialization strategies is a new policy instrument to do so) is a well-researched area in the academic literature. Besides their direct economic effects as huge employers and significant purchasers of local services, it is commonly accepted that they are one of the main sources of new knowledge, human capital and thus innovation in many economies. However, the roles they can fulfil in the economy have significantly changed over the years.

In previous centuries universities only performed educational activities and were also fewer in numbers (Goldstein 2010). Their connection with the (local) economy was slight or non-existent. The *integration of research functions into their*

missions led to the appearance of the first 'modern university', which also ensured the relatively broad financial and operational freedom its predecessor had enjoyed. Wissema (2009) categorizes these universities as second-generation universities. The fundamental purpose of this new type of university was to educate the elite of society and to achieve academic excellence; however, being intentionally practical and/or useful was missing from their educational or research agendas, which also hampered their relationship with the wider economy and society.

Until the end of 1980s the dominant view was that the educational and research activities of a university should not be constrained by financial restrictions whether these activities provided benefits to society or not (Breznitz–Feldman 2012). However, this approach has become problematic because of the enormous public financial support most of these institutions receive. Thus, lately, pressure has been put increasingly on universities to *create benefits* for the wider society as well (Goldstein 2010). In parallel, the decrease in public funds received from the central budget has incentivized universities to develop better connections with economic actors to complement their operational budget from other financial sources (Benneworth–Hospers 2007, Vilmányi 2011). Furthermore, universities have also begun to *actively participate* in the economic and social development of their surrounding areas (Goldstein 2010) and several triple-helix types of cooperation (Etzkowitz–Leydesdorff 2000) have appeared. Eventually, the above-mentioned processes together have led to the emergence of the third-generation universities (Wissema 2009) performing several new functions which could be characterized by intensive interaction between the university and economic and societal actors with the aim of intensifying the direct economic and societal contributions of universities to their regions.

However different types of universities could potentially interact with their regional economies in very different ways. Based on their wide range of functions and roles, Uyarra (2010) has distinguished five different university models which have evolved over the time, in relation to their contribution to regional development and innovation. Nevertheless, although these university models, adapting to the changing economic conditions and innovation theories, may have evolved separately from each other, they still co-exist because of varying institutional and regional contexts. The first university model, labelled the *knowledge 'factory'* (KF), has developed on the assumption that universities are the main producers of scientific knowledge and through knowledge spill-overs they could have an effect on regional innovation and growth. The main beneficiaries are mostly high-tech firms located in close proximity to universities, since it is perceived that geographical proximity facilitates the economic impact of academic research, and matters in the establishment of university-industry research partnerships (D'Este et al. 2013). Thus, the main mode of innovation could be considered to be science push. Since the key factors influencing their economic impact are geographical proximity, research intensity and excellence (because of the expected knowledge externalities) the co-location of firms and the availability of research funds, especially for basic research, are important.

The second type is the *relational university model*, which considers the exchange of knowledge as the main role of universities (Uyarra 2010). This more focused role on the establishment of collaborative linkages with industry has its origins in decreasing public funding and increasing expectations towards universities

to boost economic development. Furthermore, changes in the way of thinking about the process of innovation (breaking with the linear science push approach) also underpin this model. More emphasis has been placed on the channels through which knowledge flows between university and industry, but in this model the informal and more open or 'soft' channels are dominant (e.g. informal contacts, publications, conferences, contract research and consultancy activities, mobility of graduates, etc.). The more regulated, 'hard' channels are of lesser importance (e.g. patenting, licensing, spin-off activity). Their main partners are mostly larger manufacturing enterprises who choose their academic partners by excellence and not by geographical proximity. Relational universities establish few local linkages with smaller firms, who demand more routine activities.

The objective of an *entrepreneurial university* – as the third model in Uyarra's (2010) distinction – is to actively engage in the improvement of regional and national economic performance and to foster the financial success of the university by performing entrepreneurial activities (Etzkowitz et al. 2000). These types of universities conduct significant commercialization activities in an institutionalized way. They set up TTOs, introduce strict IP regulations, promote spin-off processes, and establish business incubators and science parks. So, in contrast with the relational universities, the more formalized and 'hard' channels of knowledge diffusion, which mostly rely on codified knowledge, are placed in focus. Accordingly, their innovation approach is rather linear and closer to the science push uptake. A frequent criticism in the literature about entrepreneurial universities is that they strive more towards maximizing their income and less to contributing to regional development, another is that many academic disciplines are unable to undertake such entrepreneurial activities (Philpott et al. 2011). Even if they are more committed to regional economic development in terms of their declared objectives, the activities they perform support it in only a very narrow sense.

The fourth university model introduced by Uyarra (2010) has evolved on the basis of innovation system theories, and is labelled the *systemic university model*. It is strongly connected to the regional innovation system approach, where the regional context, the localized, innovation-related and institutionally supported networks affect the process of innovation and the growth of a region (Uyarra 2010, Asheim and Coenen 2005). University-industry co-operations are seen as regionally embedded networks of universities, firms and other organisations (the relational model focuses on these links per se without their broader regional context). Thus, besides the aforementioned main partners, regional clusters and SMEs have also appeared among the universities' client base. Furthermore, systemic universities deliberately develop links and engage in discussions with governmental actors in contrast to the previously described types. Besides their broadened commercialization activities, they actively participate in the articulation of regional needs and the mobilization of local stakeholders in policy-making processes. On the whole the model of systemic universities has a greater focus on the regional contribution of the institution compared to the other types. However, this approach also over-emphasizes the importance of direct linkages and often implies that research, innovation and value creation would all take place in the same region, despite the fact that different university activities may have an impact on different spatial levels. In other words,

they presume that most of their activities have a direct and instantaneous impact on the regional economy.

The *engaged university* model views universities in the broadest and the most embedded sense (Uyarra 2010). They seem to be key players in economic development issues since they do not just engage in discussions about regional development but actively participate in regional policy formation. Defined in this way, these universities could be categorized as "fourth generation" universities because their main distinctive feature is proactivity. Instead of trying to meet the requirements of local economy and society, these institutions make an effort to shape their own local environment (Lukovics–Zuti 2014). Nevertheless, another frequent distinctive feature is that instead of introducing a separate third mission to contributing to regional growth and development they adopt a stronger regional focus in all of their activities (e.g. education and research) and align them better to regional needs. Regarding their partnerships, engaged universities tend to cooperate with all relevant regional stakeholders, they are more receptive to regional needs, thus they become central nodes in regional (knowledge) networks. Accordingly, their contribution is much wider than just facilitating direct knowledge transfer processes since they participate in the improvement of regional culture, society and environment in formal and/or informal ways. Furthermore, due to the stronger focus on regional context, engaged universities can be considered key channels between the global and local knowledge arenas, because they have the necessary competencies and capacities to harmonize global resources and local needs (Benneworth–Hospers 2007). However, several doubts have been raised whether engaged universities have the necessary capacity or funding to contribute to so many different fields, or how the centrally coordinated education policies, resource allocation and the relatively great autonomy of researchers affect their engagement.

4. Smart specialization in light of different university models

Based on the reviewed literature related to smart specialization, I have distinguished three essential elements of the concept, along which I have organized my ascertainments. These are: *the entrepreneurial process of discovery* which drives policy design by involving local actors to identify assets and strengths on which (innovation) policies should focus; *relatedness*, which refers to specialized diversification that enables regions to diversify into new but related industries in order to develop new growth paths; and *connectivity*, that links regions to provide external knowledge inflows related to their existing strengths and industrial structure. Then an examination of these elements was made based on the differing university models (Table 1).

Table 1 Role and contribution of different university models in designing and implementing smart specialization strategies

University models	Smart specialization elements		
	Entrepreneurial process of discovery	**Relatedness**	**Connectivity**
Knowledge factory	Passive contributor External environment: extensive knowledge Regional environment: partial knowledge	Indirect contribution Provides scientific knowledge for high-tech firms in its main research and teaching areas, irrespectively of regional needs	One-way, mostly outward knowledge flows
Relational	Passive contributor External environment: extensive knowledge Regional environment: partial knowledge	Selective contribution Exchange of knowledge based on excellence and not on geographical proximity or regional industrial needs	Bi-directional, but mainly outward knowledge flows
Entrepreneurial	Active contributor External environment: extensive knowledge in some disciplines Regional environment: extensive knowledge in some disciplines	Limited contribution Primarily provides knowledge related to 'hard sciences' with minor regional focus	Rather one-way, mostly outward knowledge flows
Systemic	Facilitator External environment: extensive knowledge Regional environment: extensive knowledge	Direct contribution Knowledge is produced and diffused in regionally embedded networks	Multi-directional, facilitates in- and outward knowledge flows Limited capabilities to align knowledge inflow and regional needs
Engaged	Committed facilitator or leader External environment: extensive knowledge Regional environment: extensive knowledge	Direct contribution Strong focus on regional needs in knowledge production and distribution	Multi-directional, facilitates in- and outward knowledge flows Key channels between global and regional knowledge arenas

Source: Own construction

The *knowledge 'factory' and relational types* of universities are able to participate in the identification *process of entrepreneurial discovery* in a very narrow and passive way. The former assumes that the knowledge it produces would automatically spill over into the surrounding area, mostly to co-located high-tech firms. So, its connections with the local actors are limited and the exploration of regional strengths is neglected. The latter, in turn, focuses on the establishment of linkages with a wider range of industrial actors but in a very informal manner and not necessarily in its host region. Thus, due to their stronger external focus, they may possess extensive knowledge about recent technologies and market opportunities but have only partial knowledge (limited to some actors/industries) in connection with their regional environment and so do not systematically participate in collaborations and discussions within the region. Accordingly, although they might be excellent in scientific terms, in the absence of proper place-specific knowledge and regional commitment they can only fulfil a passive, responding role in this process.

Because of their intensive commercialization actions *entrepreneurial universities* could be characterized by having extensive knowledge about the external and regional environment and market opportunities, but especially related to 'hard' sciences that are more closely linked to their entrepreneurial activities. This makes them an active contributor because they can (possess the 'right' knowledge) and will (included in their mission) participate in the process of discovery. The *systemic and engaged universities* possess the most extensive knowledge in connection with regional needs and non-regional trends. Their main added value to the process is their ability to identify regional strengths and weaknesses, link them to global expectations and translate these into policy recommendations. However, while a systemic university may fulfil a facilitator role and harmonizes interests between different stakeholders, an engaged university might be the leader of the whole process. And finally, the last two types can better exploit their knowledge generated by other scientific disciplines such as the arts or social sciences.

In connection with *relatedness* – specialized diversification – one could also identify differences between the contributions of different models. *Knowledge factory* type institutions can facilitate regional diversification in an indirect way. They follow a science push strategy, mainly towards high-tech industries, which often tends to overlook the existing regional industrial portfolio and only focuses on the distribution of scientific outputs. Hence there may be a mismatch between the knowledge production of universities (teaching and research) and regional needs, and KF universities mostly contribute to regional diversification if the co-located high-tech firms who benefit from the knowledge spill-overs are well embedded in the region. However, as Goddard et al. (2013) highlight in their work that the long-term adaptability of regional economies is dependent on the rarely emulated features of universities such as the wide basic and experimental research activities in which KFs are strong. *Relational universities* might contribute to specialized diversification in a very selective way. They participate in knowledge exchange processes mainly through their most excellent scientific areas, but the leading research areas of a university and the available regional assets, strengths and the regional industrial set-up or needs, do not completely corresponding (Goddard et al. 2013). Furthermore, relational universities do not have an explicit regional commitment, either.

In turn, *entrepreneurial universities* could contribute to diversification in a more direct yet rather limited way. They are able to produce and transfer the necessary complementary or related knowledge to local industries, but especially in connection with hard sciences. Thus, they are only able to provide a common scientific or technology base to a few industries. However, their entrepreneurial activities like establishing incubators or supporting spin-offs may expand the industrial structure of a region in a 'related' manner. According to Uyarra's (2010) typology, *systemic universities* are those which are embedded in their regional context the best, partly because this concept has been evolved from innovation system theories. They deliberately fulfil a boundary-spanning role which means creation, transfer and translation of knowledge between different actors embedded in the same regional (knowledge) networks. Due to their direct contribution, a wider scientific and technological platform can be developed. This common platform may be a help in building linkages between different but technologically related sectors, where intermediary industries might be weak or missing. With their stronger and more direct focus on regional context in their missions, *engaged universities* can contribute to this element of smart specialization in the most directed way. They are in a position to better align their research and teaching areas to regional needs, even if these are not necessarily their leading areas. Moreover, engaged universities can more strongly influence policies affecting their regional environment than the previously introduced models, which could also help focus priorities on the most embedded and related industries. Finally, their potential contribution is much wider than just providing technological development to their regions, since they can facilitate cultural and community development, too (Goddard et al. 2013). And these roles make it possible to facilitate diversification in lagging regions where the necessary R&D capacities are not available but social innovations could take place.

The last question is how different universities can facilitate the *interconnection of regions*, thus how they can support the inflow of external knowledge related to the existing regional industrial structure and knowledge base. Because of its strong orientation towards the exploitation of scientific outputs, a *knowledge 'factory'* type university might contribute to the outflow of knowledge and mainly provide new knowledge to other regions. Although such a university may have connections with co-located high-tech firms, because it is not necessarily embedded in the regional industrial structure, external knowledge barely reaches them from the side of university in the context of its weak regional engagement. High-tech firms, research institutions and other universities can be considered as its main partners, but they only offer a narrow and specialized external knowledge pool. A *relational type university* pays much more attention to the development of linkages with industrial actors compared to KFs, but in a very selective manner. It promotes collaboration with economic players within its excellent scientific areas. However, these areas are not always related to regional strengths, which can hinder the utilization of potentially inflowing knowledge and incite universities to look for partners in other regions. It breaks with the unidirectional approach of KFs and facilitates bi-directional channels, but the main direction of knowledge flow remains outward. So, a relational university might improve the connectivity of a region if the regional industrial structure is related to the university's excellent scientific areas. An *entrepreneurial university* can improve the connectivity

of a region in a manner similar to the aforementioned two models. It rather promotes one-way knowledge diffusion, mostly out from the region, although may facilitate the inflow of knowledge, but especially related to industries that rely on 'hard' sciences. Its external relations are much wider, and the university itself takes into account regional economic development issues, but being a central node between regional and global knowledge arenas is far beyond the scope of its activities.

Systemic and engaged universities both facilitate in- and outward knowledge flows because of their stronger regional focus and commitment. They do so with a multi-directional approach, since they tend to cooperate with a wide variety of stakeholders, within and across regions, from small and large firms to governmental actors. Moreover, engaged universities also develop close cooperation with the civil sphere. Although they understand regional needs well, they may have difficulties developing extensive external connections compared to other models because of their fragmented resources (fragmented between spatial levels and stakeholders). Nevertheless, these two types can better align regional needs and knowledge-inflows. However, the systemic model has limited capabilities to achieve this because it presumes that research, innovation and value creation can all take place in the same region, and thus to some extent it is 'locked-into' its own regional system, while engaged universities might more readily constitute integrative network nodes between global and regional knowledge arenas. Besides they scan the external environment for new, related knowledge sources, engaged universities are in a better position to translate and disseminate it between regional stakeholders.

5. Conclusion

In the 2014–2020 programming period, smart specialization has become a defining policy approach to develop regional economies in which process universities play an important role. However different types of universities contribute differently to the development of their surrounding region. Therefore, the aim of this paper was to identify the potential role and contribution of different university models in designing and implementing smart specialization strategies.

In order to do this, firstly, the concept of smart specialization was introduced and its three main elements were distinguished: entrepreneurial process of discovery, relatedness and connectivity. Subsequently, based on the work of Uyarra (2010), five different but coexisting university models were described: knowledge factory, relational, entrepreneurial, systemic and engaged. Finally, according to the distinguished elements of smart specialization, the contribution of each university model was described. Due to their objectives, roles and levels of engagement, the knowledge factory and relational types of universities can only participate passively in the entrepreneurial discovery process. Their contribution to the related diversification of the host regions is only indirect and selective, while their knowledge sourcing process are basically unidirectional. Although entrepreneurial universities can be considered an active participant in the discovery process, their contribution is still limited and tries to push knowledge and innovation onto the economy in a one-way manner. Finally, systemic and engaged universities can be the leaders of the entrepreneurial discovery process. These university types provide direct contribution

to the local economy with a strong focus on regional need, and hence, their connectivity is genuinely multidirectional. In conclusion universities are key players in smart specialization, but their role and contribution should be defined in line with their type.

Acknowledgement: This research was supported by the EU-funded Hungarian grant EFOP-3.6.1-16-2016-00008.

References

Asheim, B. T. – Coenen, L. (2005): Knowledge bases and regional innovation systems: Comparing nordic clusters, *Research Policy*, 34, 8, 1173–1190.

Bathelt, H. – Malmberg, A. – Maskell, P. (2004): Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography*, 28, 1, 31–56.

Benneworth, P. – Hospers, G. (2007): Urban competitiveness in the knowledge economy: Universities as new planning animateurs. *Progress in Planning*, 67, 105–197.

Boschma, R. – Iammarino, S. (2009): Related Variety, Trade Linkages and Regional Growth in Italy. *Economic Geography*, 85, 3, 289–311.

Boschma, R. – Gianelle, C. (2014): *Regional Branching and Smart Specialization Policy.* S3 Policy Brief Series no. 06/2014, Commission of European Communities, Brussels.

Breznitz, S. M. – Feldman, M. P. (2012): The engaged university. *The Journal of Technology Transfer*, 37, 139–157.

Camagni, R. – Capello, R. (2012): Regional Innovation Patterns and the EU Regional Policy Reform: Toward Smart Innovation Policies. *Growth and Change*, 44, 2, 355–389.

CEC (2010): *Europe 2020. A strategy for smart, sustainable and inclusive growth.* Commission of European Communities, Brussels.

D'Este, P. – Guy, F. – Iammarino, S. (2013): Shaping the formation of university–industry research collaborations: what type of proximity does really matter? *Journal of Economic Geography*, 13, 4, 537–558.

Etzkowitz, H. – Leydesdorff, L. (2000): The dynamics of innovation: from National Systems and „Mode 2" to a Triple Helix of university-industry-government relations. *Research Policy*, 29, 2, 109–123.

Etzkowitz, H. – Webster, A. – Gebhardt, C. –Terra, B. (2000): The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Research Policy*, 29, 313–330.

Foray, D. – van Ark, B. (2007): *Smart specialization in a truly integrated research area is the key to attracting more R&D to Europe.* Knowledge Economists Policy Brief No. 1., Commission of European Communities, Brussels.

Foray, D. – David, P. A. – Hall, B. (2009): *Smart Specialization – The Concept.* Knowledge Economists Policy Brief No. 9., Commission of European Communities, Brussels.

Goddard, J. – Kempton, L. – Vallance, P. (2013): Universities and Smart Specialization: challenges, tensions and opportunities for the innovation strategies of European regions. *Ekonomiaz*, 83, 2, 83–101.

Goldstein, H. A. (2010): The 'entrepreneurial turn' and regional economic development mission of universities. *The Annals of Regional Science*, 44, 83–109.

Frenken, K. – van Oort, F. – Verburg, T. (2007): Related Variety, Unrelated Variety and Regional Economic Growth. *Regional Studies*, 41, 5, 685–697.

Kempton, L. – Goddard, J. – Edwards, J. – Hegyi, F. B. – Elena-Pérez, S. (2013): *Universities and Smart Specialization.* S3 Policy Brief Series No. 03/2013, Commission of European Communities, Brussels.

Lukovics M. – Zuti B. (2014): Egyetemek a régiók versenyképességének javításáért: „negyedik generációs" egyetemek? *Tér és Társadalom*, 28, 4, 77–96.

McCann, P. – Ortega-Argilés, R. (2011): *Smart Specialization, Regional Growth, and Applications to EU Cohesion Policy.* Economic Geography Working Paper 2011, Faculty of Spatial Sciences, University of Groningen, Groningen.

Neffke, F. – Henning, M. – Boschma, R. (2011): How Do Regions Diversify over Time? Industry Relatedness and the Development of New Growth Paths in Regions. *Economic Geography*, 87, 3, 237–265.

Philpott, K. – Dooley, L. – O'Reilly, C. – Lupton, G. (2011): The entrepreneurial university: Examining the underlying academic tensions. *Technovation*, 31, 161–170.

Uyarra, E. (2010): Conceptualizing the Regional Roles of Universities, Implications and Contradictions. *European Planning Studies*, 18, 8, 1227–1246.

Vilmányi. M. (2011): Egyetemi-ipari együttműködések a kapcsolatmarketing nézőpontjából. *Vezetéstudomány*, 42, 1, 52–63.

Wissema, J. G. (2009): *Towards the third generation university. Managing the university in transition.* Edward Elgar, Cheltenham.