

TRIANGULATION OF THE TRIPLE HELIX: A CONCEPTUAL FRAMEWORK

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Abstract

Society seems more complex molecular biology itself, depleting the model of the double helix so far valid model to explain the DNA – Desoxiribo Nucleid Acid, essential for understanding the structure and activity of the DNA and heredity. The innovation of the triple helix is now required to explain the relations between the academy, industry and government. Innovation has become the decisive challenge for global competitiveness. The advantages associated to entrepreneurship are unquestionable from the point of view of regions development, taking as a strong driver of employment and wealth creation. The Academy leading role is based on human capital, through its enhancement of skills, or by knowledge transfer and technology, sometimes coated with an entrepreneurial dynamics resulting in spin-off and start-up family-oriented. The competitiveness of firms determines the flows of income and employment regions. The government is a key dimension to stable interactions between the spheres of the system's main roles in the economic and social networks to ensure cooperation, partnership and institutional support. In this context, this research aims to develop a conceptual model of triangulation of the triple helix explaining and understanding the importance of innovation and entrepreneurship within the dynamics interaction of the triple helix as a factor of competitiveness and regional development.

KEYWORDS

Innovation, Entrepreneurship, Competitiveness, Regional Development, Triple Helix.

1. INTRODUCTION

The existence of a strong national diamond cluster is crucial to an economy attaining competitive advantage (Porter & Stern, 2001; Budd & Hirmis, 2004), capable of putting those investment projects into practice able to boost competition between local rivals whilst not overlooking the need to pre-empt increasingly sophisticated and demanding client needs, and to ensure the capacities of local suppliers and industrial clusters. This framework furthermore needs to guarantee factors including market entrance requirements, scientific and technical quality and human resource management as well as sources of risk capital (Porter & Stern, 2001).

In recent decades, cooperation and networking have become the guiding paradigms for explaining and encouraging regional development. Today, regional networks increasingly have to cope with the competition posed by other networks at the global level (Semlinger, 2008). We should therefore ascertain the actual capacities of local companies to sell their products in external markets, the value

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of such sales and their productive levels of efficiency while also taking into account the incorporation of local resources and including both human and capital dimensions (Turok, 2004).

Schumpeter, in his 1911 work “The Theory of Economic Development: an Inquiry into Profits, Capital, Credit, Interest and the Business Cycle”, conceptually defined the “entrepreneur as innovator” as a key factor in fostering economic development (Wong et al., 2005). Innovative activities undertaken by entrepreneurs drive a “process of creative destruction” and triggering disturbances that end up rebalancing the economic system, creating opportunities and wealth. From Schumpeter’s (1942) perspective, entrepreneurship has taken on a steadily more important role within the overall framework of economic growth (Wong et al., 2005; Kim et al., 2011). Hence, competition correspondingly derives from feeding this entrepreneurial spirit as a driving force in modern economies and the background against which organisations engage in struggles for survival from a perspective of necessarily efficient operational processes (Nijkamp, 2003). Entrepreneurship and innovation have thus been defended by a range of different specialists as fundamental factors for bringing about economic development (Porter & Stern, 2001; Wong, 2005; Nordqvist & Melin, 2010).

Overall, the general theories apply many times in different areas, from natural areas to different disciplinary domains. The theory applies DNA (Desoxiribo Nucleid Acid) from molecular biology, agriculture, environment, human health, animal health, and etc. The generality of the application of a theory requires an interdisciplinary training and research organizations able to highlight promising areas of innovation and knowledge generation and technology, requiring an interdisciplinary division of labour that may be conferred by university and enterprise (Viale & Etzkowitz, 2010).

The fallout and pressures of the global financial crisis further heighten the importance of reflecting on regional development (Potts, 2010). The productive competitiveness of companies and the stability of relationships in terms of policy decision making relating to areas such as the transfer of knowledge and technology have been included within the Triple Helix framework: University – Industry – Government (Etzkowitz & Leydesdorff, 2000; Etzkowitz, 2003a; Etzkowitz, 2003b; Cooke & Leydesdorff, 2006), and proving fundamental to boosting regional innovation systems (Etzkowitz & Dzisah, 2008; Smith & Bachi-Sem, 2010; Galindo et al., 2011; Halei et al., 2011).

Through recourse to the bibliographic research method, based upon reviewing the deep and extensive range of literature dealing with innovation and entrepreneurship, competitiveness and regional development, in addition to the triple helix structure, this article sets out and develops a conceptual model triangulating the triple helix. This thereby explains and enables a better understanding of the importance of innovation and entrepreneurship within the dynamic interactions of the triple helix as a factor in regional competitiveness and development.

From the structural perspective, the article is broken down into eight core sections, respectively: the introduction, innovation and competitiveness; competitiveness and regional development; innovation and entrepreneurship, the emergence of the triple helix system; the triple helix and its dynamics; building a conceptual model for regional competitiveness; before closing with some final considerations.

2. INNOVATION AND COMPETITIVENESS

Competitiveness is defined by Schwab (2010) as a set of institutions, policies and factors combining to determine the level of productivity of an economy and its corresponding capacity to generate wealth and returns on investments and determining the potential for economic growth. Its entire structure rests upon twelve foundation stones: institutions, infrastructures, the surrounding macroeconomic environment, healthcare and primary education, higher education and training, the efficiency of goods markets, the efficiency of the labour market, financial market development, the technological level of development, the market scale, and the level of business and innovation sophistication.

Innovation is now a decisive challenge for global competitiveness; to achieve success companies have to know how to deal with the issues deriving, leveraging the strengths of their location for the creation and commercialisation of new products and services. In advanced economies, producing standardized products, with recourse to standard methods and processes, is now insufficient to attain competitive advantage. Companies need the skills and capacities to innovate in the global marketplace, designing, inventing, producing and selling a flow of new products, advancing the frontiers of their state of the art technology and evolving faster than their rivals. According to Porter and Stern (2001), this is characterised by capacities to, within the terms of free and fair markets, produce goods and services able to meet the needs prevailing in the marketplace, maintaining and increasing the flow of earnings to their population into the long term (Budd & Hirmisf, 2004). Furthermore, two of the leading reasons driving this strengthening of competitive pressures are the growing international mobility of capital and the openness of markets in conjunction with phenomena deriving from globalisation. Economies have strengthened their interdependence through raising levels of both exports and imports, boosting foreign direct investment, removing barriers to trade and the transnational organisation negotiating powers over the transport sector (Turok, 2004).

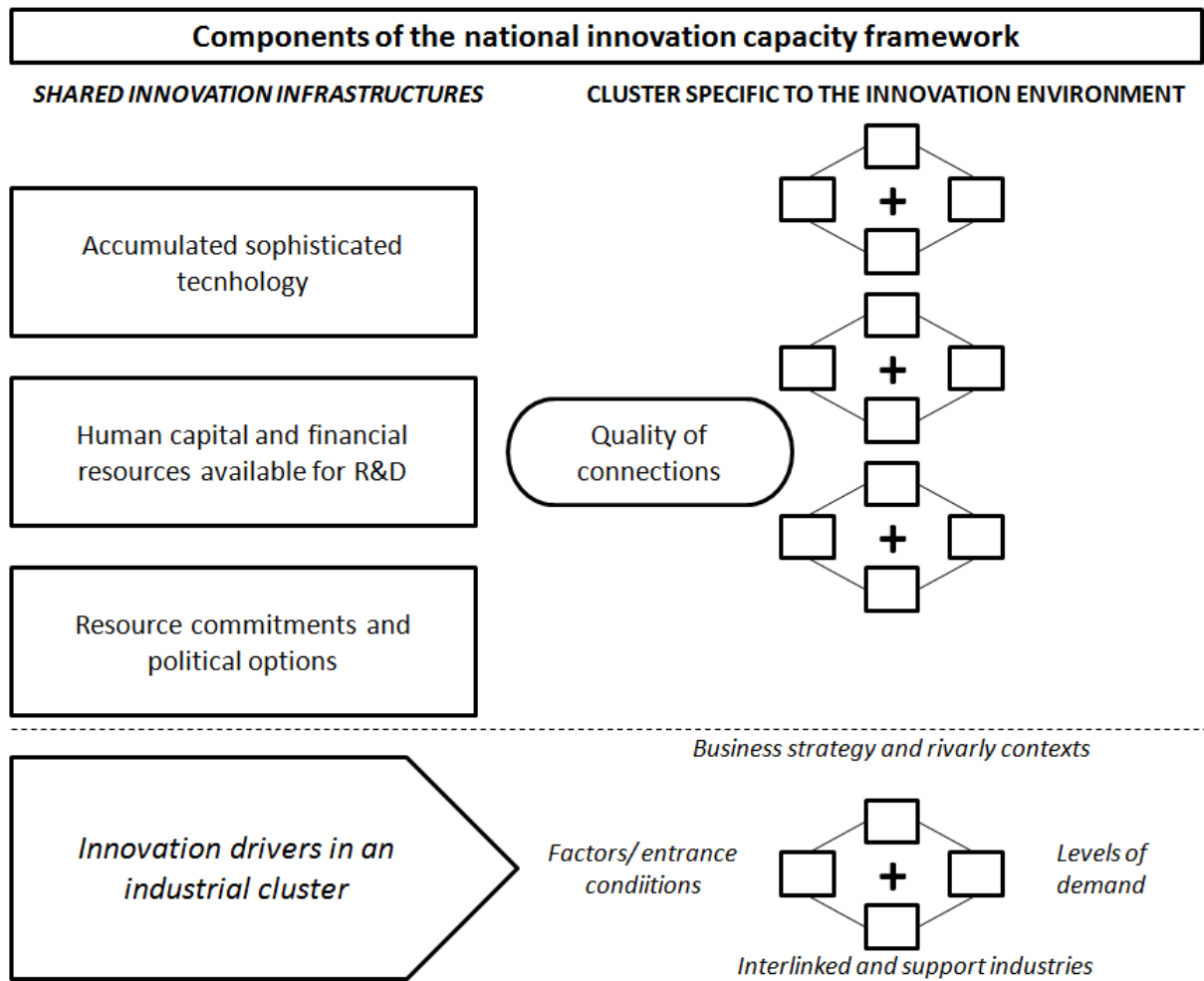
The pressures of a global financial crisis, an ageing population, the decline in stocks of natural resources and the prospects of long term scarcity and the impact of climate change represent just a beginning of the questions that need taking into consideration within the scope of regional development (Potts, 2010). Sustainability has to be approached within a perspective combining the environmental, economic and social dimensions. This thus implies that organisations, in order to reflect the current extent of the competitive advantage concept, need not only to take into account

traditional financial aspects but also environmental and social dimensions and hence including factors related to climate change, global warming, air, land and water pollution, the destruction of the ozone layer and in addition to healthcare and safety related issues, social wellbeing, fair employment opportunities, charitable institutions, cultural sensitivities and the standards now demanded of organisational behaviour (Gopalakrishnan et al., 2012). The overwhelming majority of the literature published on the link between ethics and entrepreneurship focuses on the micro level and the actions undertaken by the entrepreneur facing dilemmas that may prove particularly relevant for configuring the new venture or business and thereby having to respond to a series of issues about ethics within the context of entrepreneurial activities. These include (Harris et al., 2009): how do entrepreneurs differ from non-entrepreneurs in relation to ethics? In what way do entrepreneurs actually take ethical decisions? What ethical dilemmas emerge out of entrepreneurial related activities? In what way does technological innovation impact on entrepreneurial ethics? In what way do ethical organisational behaviours develop within the contexts of new companies? What distinguishes ethical questions in more social or non-profit based organisations?

From the perspective of Porter and Stern (2001), there is a set of factors transversal to the economy that support innovation and including: the human and financial resources allocated to scientific and technological advances, the level of technological sophistication, the public policies affecting innovation related activities, intellectual property protection, fiscal incentives for innovation, and enacting and effectively implementing antitrust and abuse of power legislation. In sum, the prevailing framework needs to encourage innovation rooted in market competition and the openness of the economy to trade and investment. While common innovation infrastructures define the prevailing conditions for innovation, companies interconnected in clusters introduce and commercialise innovations in the marketplace and including new technologies.

To describe the innovation context, Porter and Stern (2001) put forward a national framework for innovation capacities, and specifying innovation infrastructures and the clusters specific to the innovation environment (Figure 1).

Figure 1 –innovation capacity model



Source: Adapted from Porter & Stern, 2001: 29.

The relationship between shared innovation infrastructures and industrial clusters is reciprocal: strong clusters foster the shared infrastructures while also leveraging the benefits resulting. A broad grouping of formal and informal organisations, engaged in cooperation and networking, may position themselves between two fields, within the scope of which higher education stands out as a bridge between technologies and companies (Porter & Stern, 2001). From the corporate social responsibility point of view of organisations, we need to grasp the social dimensions to competitive business environments (Porter & Kramer, 2006).

Focusing on the “Comparative Advantage of Nations” theory referenced by Porter & Kramer (2006), listed the factors influencing competitive advantage and contained in the “diamond” model described as: the strategic context for companies and their rivals (the local scenarios encouraging investment and innovation through robust competition between locally based rivals), the terms of demand (sophisticated and demanding local clients and their needs); related and support industries (the presence of local suppliers able to serve related companies, the presence of clusters rather than isolated

industries), entrance factors and conditions (highly qualified human capital, especially in the scientific, technical and management fields, good basic research infrastructures at universities, high quality communication infrastructures and an ample supply of risk capital).

From the perspective of regional development, the competitive production of companies determines the levels of earnings and employability at the level of the regional business environment while demand is determined according to relative costs (Budd & Hirmisf, 2004). There is an additional set of political entities, industrial organisations and academic institutions that work in conjunction to improve and enhance local conditions for innovation and the organisation of regional processes fostering safe and secure surroundings for developing and implementing innovation based strategies – the triple helix (Etzkowitz, 2008).

3. COMPETITIVENESS AND REGIONAL DEVELOPMENT

In its most basic facets, regional (and urban) competitiveness may be defined as the success regions and cities attain in ongoing mutual competition that occurs in different forms, whether from the point of view of actions and results in national and international markets or whether as regards the capacity to attract financial and human capital resources (Audretsch et al., 2011). The term “Region” traces its origins to the Latin “*Regio*”, which in turn derives from “*regere*”, meaning “to govern”. In the field of regional development, the term “Region” has been applied to define the governance inherent to policy decision making on issues relating to support for economic development processes. Administratively, “Region” is a territorial division in effect in Portugal’s case, for example (Cooke & Leydesdorff, 2006). The idea of regional competitiveness, according to Audretsch et al. (2011), and reinforcing the vision set down by the European Commission in 1999, should incorporate the fact that despite having both highly competitive and non-competitive companies in each region, there are shared characteristics within any particular region impacting on the respective levels of competitiveness attained by all companies located within its extent.

According to the logics underpinning regional development, the predominance of the relationships between universities–industry–government (state or municipal) and specific local activities (for example, local technology transfers, the development of human capital and networking), in conjunction, determine better overall results (Smith & Bagchi-Sen, 2010).

Development may correspondingly be broken down into exogenous development and endogenous development. Exogenous based factors derive from the respective importance of importing technology and foreign direct investment, sometimes bound up with natural resource extraction. Endogenous development, in turn, is based on boosting local stocks of intellectual capital and support to institutions such as higher education facilities, research centres, company incubators and scientific parks with the purpose of aggregating the value of resources ranging from the agricultural sector through to all the different fields of the economy.

Innovation is now generally accepted as a critical parameter of human intelligence and cognitive capacities (Galindo et al., 2011). The regional innovation concept is based on an interactive set of private and public interests, formal institutions and other entities that operate in accordance with organisational and institutional agreements and establish relationships leading to the generation and dissemination of knowledge. The concept involves analysing the existence of actors (institutions, groups, universities, industries, ...) and regional competences as well as the ongoing inter-network interactions engaged with innovation related purposes within the scope of the overall objective of providing the local and state authorities with tools for defining policies able to boost real competitiveness (Huahai et al., 2011).

Representing the foundation stone of the triple helix model, intellectual resources are, in principle, continually renewable, subject to strengthening and deepening, and therefore stand out as the single best source for regional development (Etzkowitz & Dzisah, 2008). The theory of economic growth has undergone an impressive rebirth in recent times, particularly in terms of the publication of studies on the new economic geography based on endogenous growth theories and serving to heighten global interest in the driving forces and socioeconomic impacts of innovation and entrepreneurship.

In industry, Lundberg and Andresen (2011) testify to how company behaviour and performance does not only depend on endogenous factors but also on their relational networks. Cooperative relationships designed to bring about research and development constitutes a proven explanatory factor for differences observed in levels of innovation and not only between companies but also between regions. In the academic sphere, there is a vast body of literature on the economic impact of universities, whether at the regional level or the national level, and establishing the contribution made by research and development towards gross domestic product. According to some authors, these studies need to advance still further and integrate the dynamic impact of universities on regions as regards all activities ongoing, including, but not exclusively, research and development (Martin, 1998).

Consistent to this interpretation, a series of academic studies has recognised that cooperation between the three institutional spheres (university – industry – state) is fundamental to improving regional and national innovation systems (Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz & Leydesdorff, 2000; Cooke & Leydesdorff, 2006; Leydesdorff & Meyer, 2006; Etzkowitz & Dzisah, 2008; Smith & Bagchi-Sen, 2010; Galindo et al., 2011; Huahai et al., 2011).

4. INNOVATION AND ENTREPRENEURSHIP

Ever since the founding of economic history (Adam Smith, Ricardo), entrepreneurship has been identified as a critical factor to attaining and maintaining successful economic development. In the 20th century, Alfred Marshall, within the context of growth in capitalist economies, directly defined the notion of entrepreneurial competition (Nijkamp, 2003).

Entrepreneurship stands at the centre of economic and industrial policies and incorporates both the founding of new businesses and the development of new business opportunities in already existing firms. Entrepreneurship is, in accordance with the definition set out under the auspices of the GEM (Global Entrepreneurship Monitor) project, an attempt to launch a new business or new initiative, increasing current employment levels and either a new business organisation or the expansion of an already existing firm (GEM, 2007).

Regional policies aim to nurture spin-off companies as an important mechanism for deepening university-industry relationships and generating employment and wealth. Science parks represent an organisational innovation that spread globally throughout the latter half of the 20th century, fostering the emergence of technology-based initiatives. The presence of company incubators may also enhance the opportunities for networking, providing tenants (companies) with the appropriate technical and other support infrastructures and services (Salvador, 2010).

Experiences in the higher education system may establish the framework for building up personal networks, and, to the extent these networks are localized, may drive the creation of social capital incorporated into the core of local entrepreneurial activities (Baltzopoulos & Broström, 2011).

Entrepreneurship represents a high risk dynamic and a highly elevated binomial level of effort – reward, where an entrepreneur's success is very often arising out of a mixture of luck, a good idea, the possession of the right information, combined with competitive decision making processes. The relevant information should be integrated into a business-plan based project, involving analysis of the sources of opportunity and other research outputs dealing with the knowledge underpinning the new business or entrepreneur venture, for example, digitalised databases and centres of local economic development (Kirkwood, 2010).

In the family-based entrepreneurial perspective, Nordqvist and Melin (2010) define three themes for their familiar entrepreneurial model: Actor, Activity and Attitude (the three A's). The actor refers to the family as the entity engaged in business related activities and not limited only to the social or organisational context. Activity means a specific action or process undertaken by the family, endowed with entrepreneurial significance within the domestic environment of the family itself, the family firm or, in a broader context, within the framework of developing the respective region. Attitude reflects the mentality and the approach of the family to processes and dynamics of the business.

The advantages associated with entrepreneurship prove unquestionable from the GEM perspective: the creation of new companies resulting from investment in the heart of the local economy, creating new jobs, enhancing competitiveness and developing the tools serving innovative businesses. Entrepreneurship thus becomes a core driver of employment and economic growth and a key factor in sustaining competitive and globalised market economies (Kelley et al., 2011).

Nijkamp (2003) defends that one of the key drivers of change leading to a new balance is centred around innovation as such is capable of advancing existing standards of productivity through serving as a creative “*modus operandi*” for entrepreneurs and enabling processes of economic growth. Companies seek out discontinuous innovation and thereby tend to build up partnerships and in some instances transferring units to science parks to ensure an even closer relationship with academic research groups (Etzkowitz, 2008).

In the GEM conceptual model, the “entrepreneurial opportunities” are bound up both with the existence and capturing of market opportunities and the evaluation of the “entrepreneurial capacity”, the potential, the experience and the motivation of individuals to launch businesses, such as the necessary skills leading to the successful implementation of entrepreneurial initiatives. Additionally, the opportunities and capacities determine the entrepreneurial activity (Early-Stage), resulting in a rate of entrepreneurial activity - REA (Rate of Early-Stage Entrepreneurial Activity) with innovation representing a significant share of the factors contributing towards “economic growth” (Kelley et al., 2011).

The GEM model takes into account the social, cultural and political context of the surrounding environment, subdividing the social conditions into two branches – firstly, the economic factors required for developing entrepreneurial activities: “structural conditions” – including the level of openness to the market, the government’s role, management, technology, R&D, the physical infrastructures, the financial and labour markets in addition to all the social and legal institutions. The second branch covers the “structural entrepreneurial conditions” and including factors such as financial support, government policies and programs, education and training levels, transfer of R&D results, commercial and professional infrastructures, openness to internal markets, access to physical infrastructures, social and cultural norms and the protection granted to industrial property rights. Driving the growth of companies and the development of entrepreneurial opportunities, skills and capacities, through the creation of employment and technical innovation ensures both regional and national economic growth (GEM., 2007; Kelley et al., 2011). The model furthermore takes into consideration how economic prosperity to a large extent depends on the dynamics ongoing across business sectors, irrespective of the stage of development while not overlooking the sheer variability in entrepreneur profiles (Kelley et al., 2011).

5. THE EMERGENCE OF THE TRIPLE HELIX SYSTEM

Contemporary relationships deriving from interactions ongoing between the spheres of university and industry are resulting in a third hybrid current whether out of common interests in basic research, partnership projects between industry and higher education institutions as well as through the joint

establishment of research and development programs making recourse to multiple sources of financing (Etzkowitz, 2008).

Various evolutionary stages need accounting for in terms of the many interactions between the triple helix spheres. Out of what has been entitled the scientific-technological revolution, before which the absolute dominance of the government sphere prevailed over those of universities and industry, especially since the collapse of the most extreme of such regimes (those found in the now formerly communist countries), there arose added difficulties in justifying the involvement of the state beyond certain core activities and factors of social well-being. Within the current context, the analysts and political decision makers turned to the concept of innovation, a new conceptual framework providing a new justification of the role of government in the economy and, when adopting the logics driving interactions within the triple helix concept, thereby enabling and encouraging the emergence of new hybrid organisations (Etzkowitz, 2003a; Etzkowitz, 2008).

Theories falling under the scope of the Triple Helix approach provide some evidence that universities may perform a heightened role in innovation within the context of knowledge based societies (Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz & Leydesdorff, 2000; Etzkowitz & Dzisah, 2008; Leydesdorff & Meyer, 2006). While the knowledge based systems may be considered inherently a result of the different mechanisms of social coordination – markets, the production and the management of knowledge (public and private), the relationships ongoing in the triple helix model prove heuristic to the study of the complex dynamics taking place within the framework of institutional networks involving the respective actors: university – industry – government (Leydesdorff & Meyer, 2006).

The Triple Helix model centres on interactions between universities² – industry – government as the key to improving the conditions required for the innovations at the heart of knowledge based societies. Industry becomes the dynamic to the triple helix, taking on the role of production while the government is attributed responsibility for overseeing the contractual relationships capable of guaranteeing interactions and stable relationships of exchange with universities allocated the role of producing new knowledge and technology. This represents the principle of production underlying knowledge based economies (Etzkowitz, 2003a).

The higher education system has become entrepreneurial broadly through internal dynamics while also driven by external contacts to private sector firms within the scope of research contracts and transfers of knowledge and technology (Etzkowitz, 2003b). Given such progress in understanding the transformations taking place in economic relationships, the priority moves onto clarifying the core features of interest and the perspectives they encapsulate (Cooke & Leydesdorff, 2006).

² Though some authors adopt the term academia (Leydesdorff & Meyer, 2006), in this paper the terms university and academia are simultaneously used in referring to higher education institutions.

According to Etzkowitz (2003a), the triple helix dynamic is based upon the range of agreements and partnership networks occurring between the respective institutional triple helix spheres and actually proving able to better advance new sources of innovation in comparison with any isolated initiative designed to generate such results. Correspondingly, attention is drawn to incubators and science parks in conjunction with the networks established between the different triple helix partners driven by a shared desire for research based cooperation and the implementation of new entrepreneurial projects.

Adopting policies able to drive convergence and synergies between the higher education system and companies leverages comparative advantages for some universities thereby enabling teaching to be complemented by research, which would suggest that this support variable, where not accelerating, at least fosters new technological and other developments (Yusuf & Nabeshima, 2007).

The interaction between linear dynamics and reversible dynamics results in an interactive innovation model: the linear model of knowledge transfers within which technology generated in higher education units is transferred out through intellectual property licensing services or training provided to companies in the incubator phase, for example. In contrast, the reversible linear model emerges out of the industrial and social problems that supply new and evolving grounds for new research programs (Etzkowitz, 2003a).

The triple helix model of development is inherently rooted in the transition from an industrial society to a knowledge based society within the scope of which universities play an increasingly important role in innovation and development all the while technology transfers turn into processes tending to shrink in scale with steadily more flexible organisations tending to prevail. We should highlight the emergence of adaptable and multipurpose knowledge in fields such as biotechnology and computer sciences that manages to be simultaneously theoretical and practical and eligible for patenting and publication (Etzkowitz & Dzisah, 2008).

The "capitalisation" of knowledge drives financial capital into acquiring ever greater inputs from knowledge through invention, the sharing of new risks and mechanisms for attracting investment as is the case with risk capital companies. Capital is now established and built up according to new dimensions: financial, social, cultural and intellectual. Newly capitalised companies are based on social interaction, within which human, social and intellectual capital are redefined within a perspective of more intense interaction and cooperation between the university, industry and government helix components (Etzkowitz, 2003a).

Aligning the triple helix system to the regional competitiveness factor and the innovative activities of local companies, based upon knowledge and high technology, proves the point of departure for a better theoretical understanding (Galindo et al., 2011).

Globalisation has become decentralised and takes place through regional networks whether of universities or of multinational companies and organisations. Countries and regions experiencing development gain the opportunity to make rapid progress when able to root their development strategies in building up niche sources of knowledge. Support from the political and local economic frameworks need to ensure that principles of equity and transparency establish the foundations for swift growth within a stable prevailing environment (Etzkowitz, 2003a).

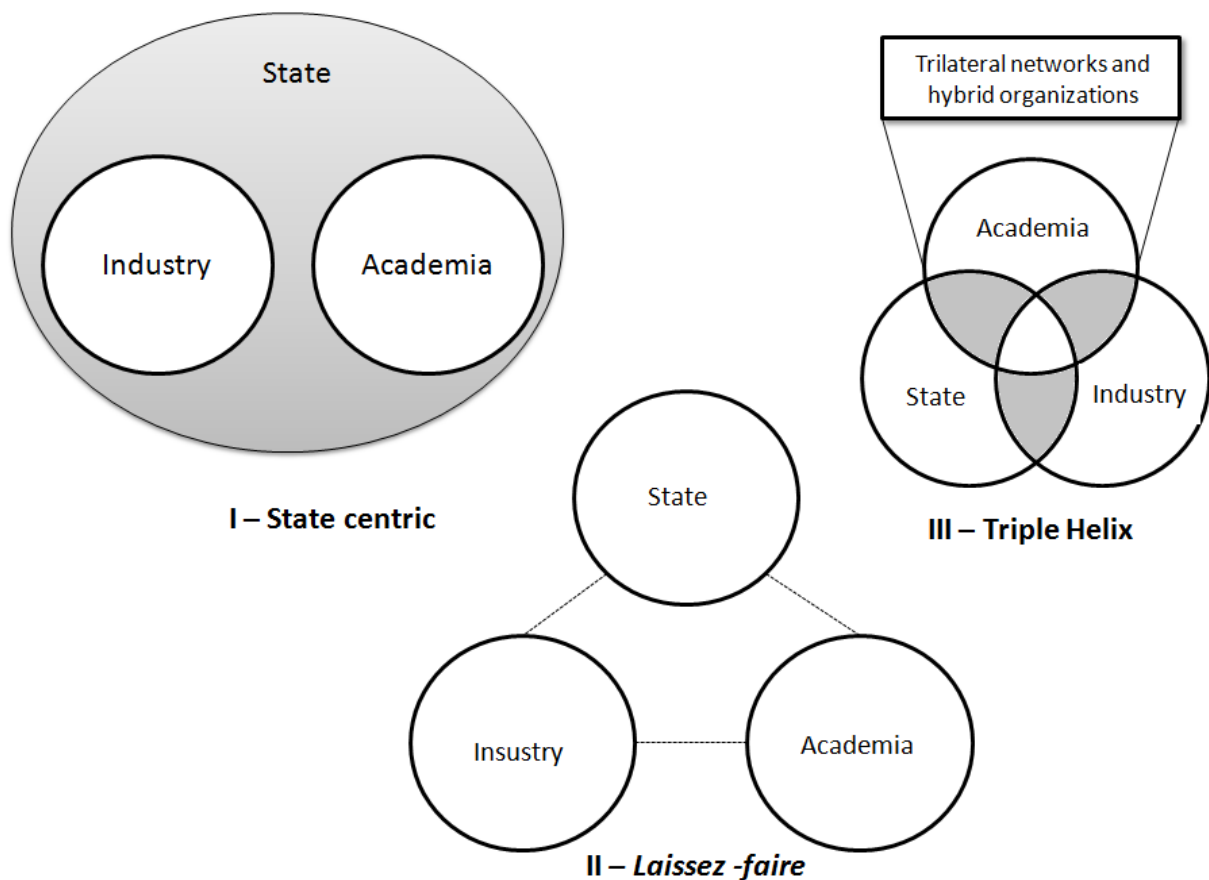
As an analytical model, the triple helix also incorporates descriptions of the sheer variety of institutional agreements and political decision making processes in effect. In practice, this represents an explanation of its own dynamic and producing answers to questions such as (Etzkowitz & Leydesdorff, 2000): which units are brought into operation in the founding of an innovation system?, and just how can such systems be specified?

6. THE TRIPLE HELIX AND ITS DYNAMICS

The evolution of innovation systems and the current dispute over which path is most appropriate for university–industry relationships effects the different institutional agreements in terms of the overall university–industry–government relationships (Etzkowitz & Leydesdorff, 2000).

State– industry–university relationships have been subject to various configurations over the course of history (figure 2).

Figure 2 – From “state-centric” to the *laissez-faire* and triple helix models



Source: Etzkowitz (2003:302)

In the first configuration (I – State-centric), the reach of the state extends over both industry and the higher education system and guiding and structuring their mutual relationships. This model was implemented to an extreme extent in the Soviet Union and the formerly Socialist countries of Eastern Europe and remains in effect in far weaker versions in some European countries such as Norway (Etzkowitz & Leydesdorff, 2000).

The second model of political decision making (II – *Laissez-faire*) involves the separation of the three institutional spheres: university – industry – government through the intermediation of strong barriers with only modest mutual interactions and highlighting the existence of autonomous movement in the direction of a new global model for managing knowledge and technology (Etzkowitz, 2003a; Etzkowitz & Leydesdorff, 2000).

The evolutionary perspective of model (III – Triple Helix) facilitates the generation of a knowledge based infrastructure overlying the different institutional spheres, where each takes on the role of the other within the framework of an emerging tripartite interface between hybrid organisations (Etzkowitz & Leydesdorff, 2000).

Given contemporary societies are no longer coordinated by some central power, a “Rome” or a “Moscow”, but which function in terms of interactions through diverse codified communications, the current triple helix model is open to the presentation of proposals extending the model to four or more helixes (and potentially incorporating an alphabet of twenty or more helixes). This would expand its potential coverage to new communication variables that might be power, truth, trust, emotional intelligence or other interfaces relating to intellectual property protection rights (Leydesdorff, 2011). Reinforcing this thesis of expanding the triple helix model, MacGregor et al. (2010) defend how the triple helix innovation process may serve as the core foundational model for evolutionary progression to a quadruple helix that totally integrates the spheres and where the overlapping roles serve to create or discover new knowledge, technologies or products and services from a perspective of meeting a social need. Making references to studies undertaken by different authors, Leydesdorff (2011) highlights the case of Japan in the 1990s in which the addition of an extra, fourth, helix was necessary as in addition to the relationships ongoing between university – industry – government, internationalisation also played an important role in the economy just as the emergence of the Internet deepened and strengthened globalisation through the provision of a new means of professional communication.

Referred to by some researchers within the scope of a fourth helix-pillar are independent organisations, without any profit motive and combining public and private financing. They seek to play a facilitating role between the three traditional pillars (academy – industry – government), channelling public and private investment while simultaneously planning the division of costs associated with research and development (R&D) programs, sharing infrastructures and supplying technical products and services. They furthermore aim to establish leadership networks in industry and university, set up R&D focused partnerships, facilitate the pathway to excellence through the attraction, development and retention of the highly qualified individuals (MacGregor et al., 2010), necessary to regional competitiveness and development (Audretsch et al., 2011).

6.1.THE ACTIVE UNIVERSITY ROLE

While universities produce consumer goods, such as entertainment and culture, their core purpose consists of strengthening human capital, raising and refining the skills and capacities of their graduates, fostering talents, curiosity, imagination and creativity (Siegfried et al., 2007).

In the study published by McAdam et al. (2011), on the development of the university’s role in the transfer of technology to interested parties at the regional level, three potential means of aggregating value for regional development are put forward: the regional benefits of universities (population growth, job opportunities, increasing spin-offs and other costs), the benefits implicitly deriving from growth in the “knowledge economy”, and the response capacity through the supply of flexible and innovative solutions to the front-line of an economy undergoing rapid mutation within a concept of

regions acquiring knowledge and including universities. Furthering this analysis, Dinapoli (2011) highlights how higher education institutions act as catalysers of economic growth and serve as the fuel to drive new ideas and technologies through building up a qualified workforce, establishing partnerships with private sector entities and investors. The university may also help reposition regions within the framework of knowledge economies, fostering their development through the conversion of research outputs into new products and businesses, generating employment and wealth (Dinapoli & McAdam, 2011).

In the analysis produced by Bathel et al. (2010), there emerge differences in the descriptions of spin-off related phenomena, building on and clarifying Etzkowitz et al. (2000) as regards the significance of academic spin-offs and entrepreneurial start-ups as a mechanism for transferring technology leading to regional economic competitiveness and development.

Confirming this perspective as to the economic impact of higher education at the regional level, Dinapoli (2011) points to a July 2011 New York state public information report on the importance of higher education to the region. That level of education is openly accepted as a major industry to the region, employing over 265,000 people, paying out over \$13 billion in salaries in 2009 and with a total number in excess of 1.2 million students enrolled, of which around a fifth are registered on post-graduate programs (including law, the medical sciences, theology, ...).

Higher education performs an important role in revitalising regional economies especially when taking into account all the related expenditure on and off academic campuses whether on personnel, investment in research and new projects, medical installations, arts and cultural events, hosting conferences and congresses, equipment and other infrastructures as well as food and beverage outlets. Such advantages come in addition to all the value of the skills and competences learned and enabling students to apply such gains to leverage their own lives and highlight the importance of geographic proximity to knowledge transfer processes (Bramwell, 2008; Garrido-Yserte & Gallo-Rivera, 2008; Eom & Lee, 2010; Dinapoli, 2011). Proximity as a source of research proves important in determining success in transferring the knowledge generated in laboratories to businesses and enabling their deployment in commercial development and the adoption and spread of innovation processes (Bramwell & Wolfe, 2008).

Referring to the entrepreneurial initiatives emerging out of university environments, Arroyo-Vázquez et al. (2009) emphasise the need for a creative and innovative stance in order to generate integrated models able to reach out to the different interested parties and their respective objectives, transferring knowledge and enhancing company growth within the context of entrepreneurial universities. In contrast to the classical concept of university and its social contribution, this entrepreneurial university approach constitutes a powerful development concept proposing a flexible organisation that interacts with its social and economic environment, adapting to change, seeking out additional sources of

resources whether for researching or transferring technology and leveraging its commercial value, not only managing all these activities entrepreneurially, but also establishing relationships with a varied range of interested parties.

Entrepreneurial universities represent independent higher education institutions, free of state or industrial control, displaying a high degree of autonomy in defining their own strategies and missions and participating as an equal in other institutional spheres, in formulating joint projects for economic and social development, particularly at the regional level. Given that not all universities are able to attain such entrepreneurial profiles (whether due to a lack of interest in commercialising knowledge and discoveries or participating in initiatives designed to improve social welfare), the entrepreneurial university model has been found to expand especially through engineering activities and managing activities undertaken out of social objectives (Etzkowitz, 2008).

According to Van Looy et al. (2011), the logic of "university ventures" is tightly bound up with the existence of shortcomings in the innovation market.

There are two trends shaping the framework of contemporary developments in relationships between university and industry: interests in basic research financed by research entities and councils and industrial projects, which universities are invited to participate in with a third hybrid current emerging with the formulation of joint research programs making recourse to multiple sources of financing (Etzkowitz, 2008).

7. CONSTRUCTING A CONCEPTUAL MODEL FOR REGIONAL COMPETITIVENESS

Contemporary society turns out to be more complex than even molecular biology and exhausting the scope of the double helix model for explaining inter-related phenomena. However, the literature on the emergence of the triple helix model unanimously states the need for university – industry – government interactions to become the key to innovation in knowledge based societies (Etzkowitz, 2003a).

The triple helix development model fundamentally rests on the paradigm change from an industrial society to a knowledge based society. This correspondingly attributes an important role to innovation and development through their roles in transferring knowledge and technology (Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz & Dzisah, 2008; Galindo et al., 2011); reflected in the various different institutional agreements in terms of the relationship between spheres and the transformations taking place in terms of the economic relationships in effect (Etzkowitz & Leydesdorff, 2000; Cooke & Leydesdorff, 2006).

Given the changes in societies that have shaken off domination by a central instance, some authors have felt the case for presenting possible new alternative model scales with four or more helixes based on new variables (Leydesdorff, 2011; MacGregor et al., 2010) fostering regional competitiveness and development (Audretsch et al., 2011).

Appointing innovation as the decisive challenge to overall levels of competitiveness, Porter and Stern (2001) refer to a model framework portraying necessary innovative capacities and reporting on the specific infrastructures and clusters present in innovative environments.

Backing up this perspective on how regional competitiveness and development determine the productive capacity of companies and regional levels of income and employability (Budd & Hirmisf, 2004), other authors highlight the predominance of relationships between university – industry – government (state, regional or local) and specific local activities in determining the best business results and outcomes (Smith & Bagchi-Sem, 2010). A set of political entities, industrial organisations and academic institutions jointly work together within the overall objective of boosting the conditions for innovation and organisation able to drive regional development processes (Etzkowitz, 2008).

Beyond exogenous developments, brought about by the arrival of technology and foreign direct investment, endogenous resources now need new standards of competitive improvement. The increasing levels of local intellectual capital and institutional support (Etzkowitz & Dzisah, 2008) enable the development of an interactive group of private and public interests, acting through a network of organisational and institutional agreements and fostering the dissemination of knowledge, technologies and regionally located innovation skills and capacities (Huahai et al., 2011).

Irrespective of financial pressures within the current context of global crisis, in cases compounded by demographic ageing or alternatively by a drop in the level of natural resource reserves as factors constraining regional development levels (Potts, 2010), in their model for building up national innovation capacities, Porter and Stern (2001) stress the need for networking by both formal and informal organisations, displaying a structured set of drivers within the context of innovation oriented clusters.

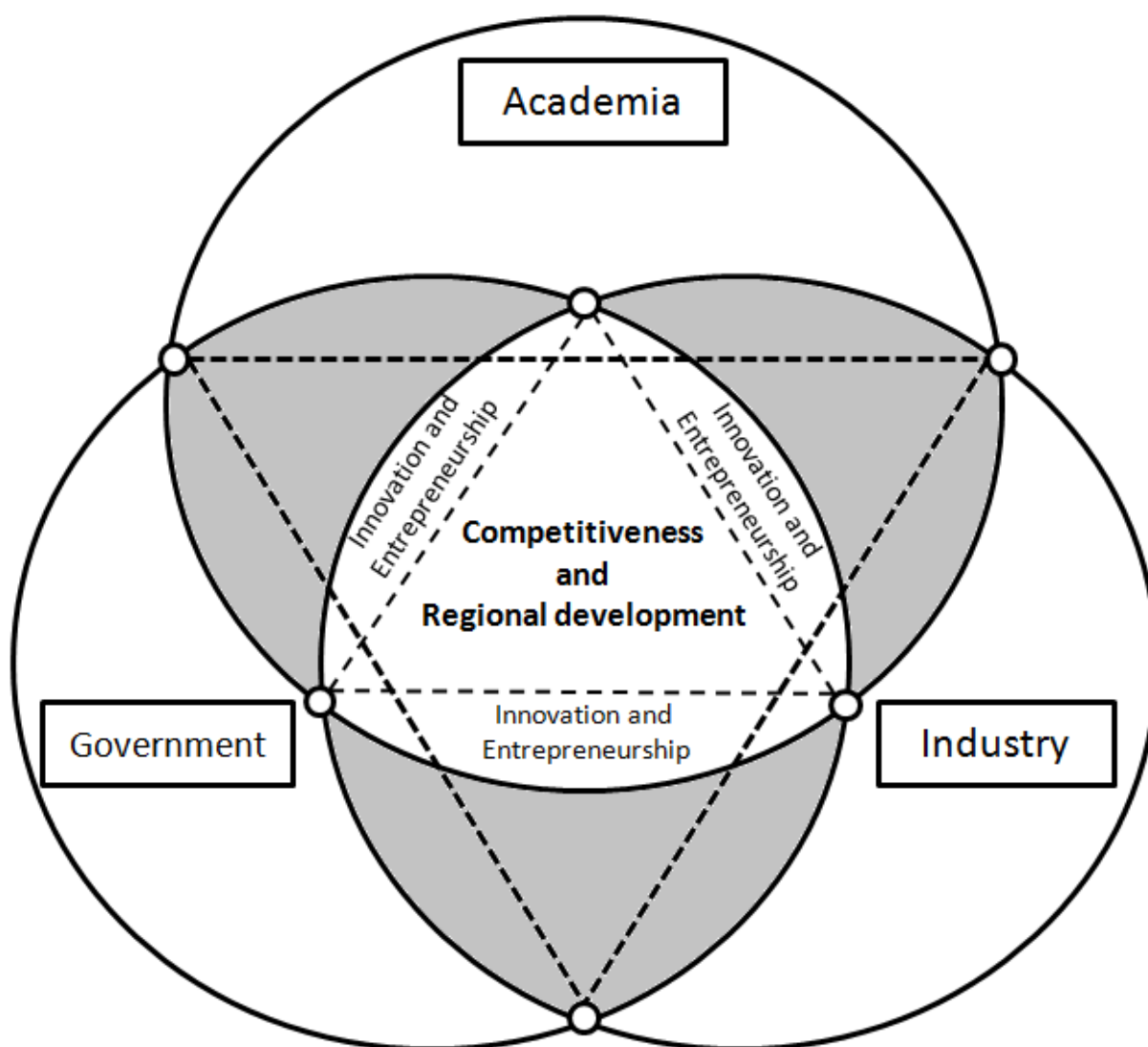
From the Global Entrepreneurship Monitor perspective, launching new companies results in investment and job creation enhancing greater competitiveness and development and correspondingly boosting local economic growth (Kelley et al., 2011).

The definition and explanations of regional competitive advantage extend far beyond any production focused concerns. The quality and abilities of the labour force (human capital); the extension, depth and focus of social and institutional networks (social/institutional capital), the range and quality of installations as well as cultural assets (cultural capital), the presence of a creative and innovative class (knowledge/creative capital), and the quality of infrastructural policies and results (infrastructural

capital) are all deemed to be critical factors in supporting and determining regional economic outcomes (Kitson et al., 2004).

We now proceed, following the literature review above, with setting out a new conceptual model (Figure 3), based upon the Triple Helix model, defended by a vast range of authors (Cooke & Leydesdorff, 2006; Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz & Leydesdorff, 2000; Etzkowitz & Dzisah, 2008; Galindo et al., 2011), focused on innovation and entrepreneurship as critical factors to regional competitiveness and development through their capacities to stimulate new investment and job creation, thus driving economies to attain new standards of competition (Kelley et al., 2011).

Figure 3 – Proposed new conceptual model: Triple Helix Triangulation



Building on the work of Porter and Stern (2001) and the need for inter-organisational networks, Huahai et al. (2011) stress the need for the interactive engagement of public and private interests based

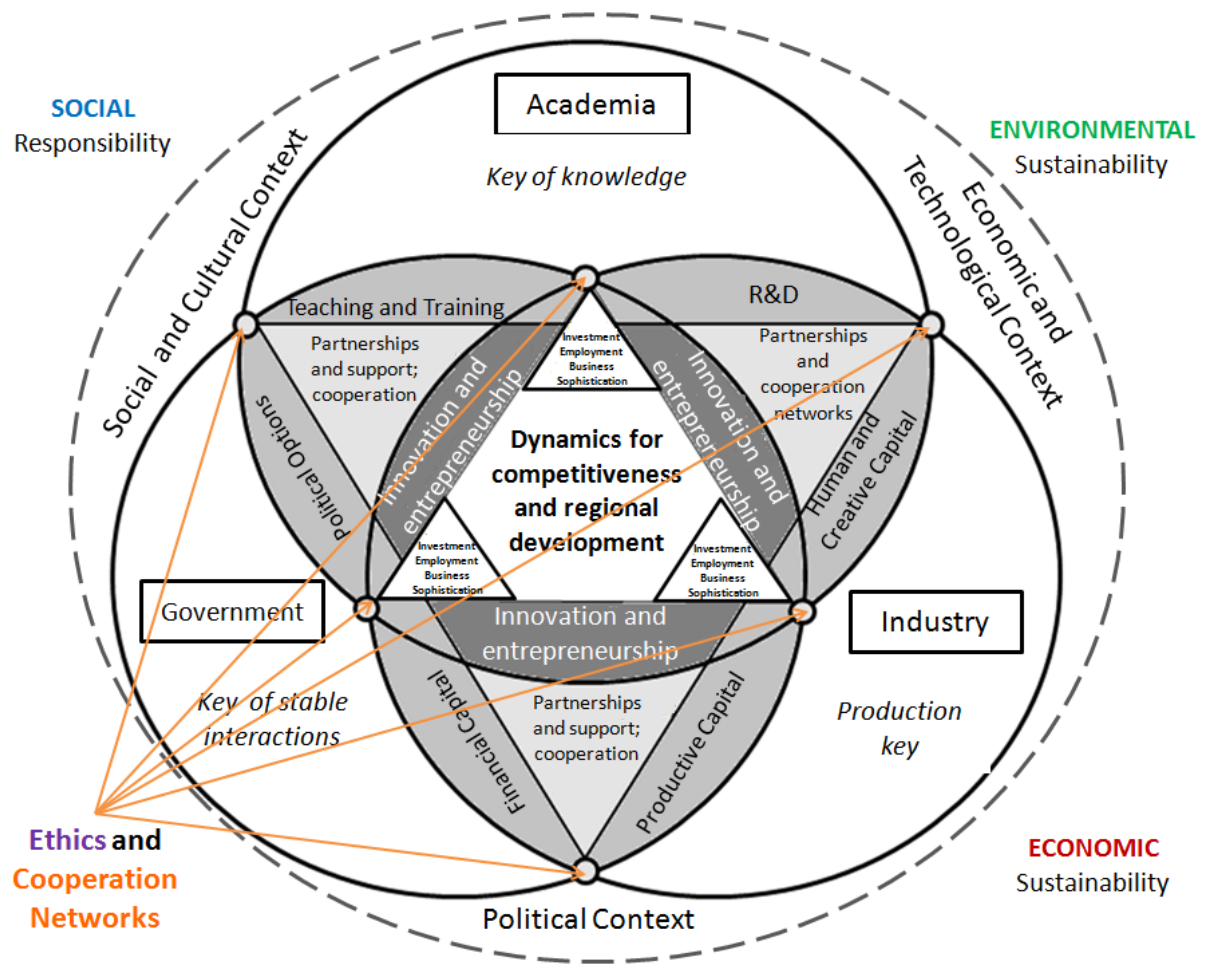
on the dissemination of knowledge and technology within the context of a new regional innovation clusters.

The triple helix spheres, while set out contextualised within their external environment (the political, economic, social, cultural and technological contexts), as dealt with in the Global Entrepreneurship Monitor report in Kelley et al., (2011), describe the dynamic and interactive movements of partnerships, supported by and in the format of cooperative networks striving to boost competitiveness, a perspective also defended by Huahai et al. (2011).

As proposed by Kitson et al. (2004), regional competitive advantage furthermore inherently requires articulated involvement and action across a multi-level scenario, within which feature the different variants of capital. The model put forward foresees articulated and dynamic interactions between teaching and research, R&D, human and creative capital; productive capital, financial capital, as well as political options. Supporting the Kelley et al. (2011) perspective, these capital factors combine to establish partnership and cooperation networks enabling the pro-innovation and entrepreneurial environment necessary to attracting investment and providing employment through the creation and maintenance of jobs (enhanced through the valuing of personal competences). Furthermore, increased business sophistication similarly confers a higher level of regional competitiveness through the provision of non-standardised goods and services of greater added value in the marketplace.

Seeking to aid in describing and clarifying the dynamics underlying regional competitiveness and development, the Triple Helix Triangulation model features a new model leveraging the dynamics present in the triple helix focusing on local innovation and entrepreneurship as catalysers of development and a region's ability to compete globally based upon networked management and rooted in the three pillars of sustainability: environmental, economic and social (Figure 4).

Figure 4 – Triple Helix Triangulation Model



The Triple Helix Triangulation (THT) model is structured around the interactive relationships between the three institutional spheres (university – industry – government) referred to by various authors (Etzkowitz, 2003a; Etzkowitz & Leydesdorff, 2000; Etzkowitz & Dzisah, 2008); Huahai et al., 2011; Leydesdorff, 2011; Leydesdorff & Meyer, 2006; Smith & Bagchi-Sem, 2010), as key institutions to the knowledge that itself is the key to production that becomes the key to stable interactions.

Entrepreneurial dynamics constitute an important mechanism to regional development, whether deriving from academic spin-offs, rendered support by science and technology parks and incubators, as defended by Salvador (2010); or resulting from the founding and expansion of family based companies, as proposed by Nordqvist Melin (2010) and, in either case, resulting in locally produced employment and wealth.

According to Gopalakrishnan et al. (2012), sustainability should also be perceived of within a three-dimensional approach: environmental, economic-financial and social, thereby boosting the competitive advantage of regions. Harris et al. (2009) point out how ethics and entrepreneurship

remain inherently bound up and of particular relevance within the framework of entrepreneurial activities and regional development.

8. FINAL CONSIDERATIONS

This study aims to put forward a conceptual model displaying a dynamic and interactive triple helix framework able to clarify the importance of innovation and entrepreneurship as factors of competitiveness and regional development. Entrepreneurship is defined in the literature as a high risk dynamic and with an especially high binomial level of effort-reward.

Companies need to be able to innovate in the global marketplace, designing, producing and commercialising new products and evolving faster than their rivals. The development of regions may correspondingly be segregated into exogenous development and endogenous development (Etzkowitz & Dzisah, 2008). The triple helix model focuses on interactions ongoing between universities – industry – government as the key to improving the conditions necessary to innovation, based on changing the paradigm from industrial societies to knowledge based societies.

Strengthening this perspective on regional competitiveness and development, the productive private sector capacity determines the prevailing levels of regional earnings and employability (Budd & Hirwist, 2004). From the Global Entrepreneurship Monitor perspective, the launch of new companies results in investment inflows, new jobs and driving overall competitiveness and development (Kelley et al., 2011).

The Triple Helix Triangulation relational model reflects the interaction of relationships ongoing between three institutional spheres (university – industry – government) designed to secure regional competitive advantage within the framework of actions interrelated across a multi-level scenario.

The Triple Helix Triangulation model thereby serves as the point of departure for designing and implementing empirically based studies, susceptible to providing responses to the questions raised relative to the interactions taking place in the different spheres. This is, in turn, based on the assumption of a positive relationship between the dynamics of innovation and entrepreneurship for regional competitiveness and development that needs empirical validation with recourse to the appropriate research methodologies (quantitative and/or qualitative).

Considering the pertinence of developing this theme in future research, and irrespective of the prevailing economic conjuncture – with recessionary pressures at the global level and reflecting in the rescaling and postponement of new investment projects despite the corresponding need for job creation within the framework of a globalised and competitive economy in which innovation stands out as a key factor for competitiveness, combine to ensure the priority attributed to regional development and its associated competitiveness. This inherently requires the dissemination of

knowledge and technology through a sustainable inter-organisational network. Based on this assumption, as future lines of research, we would suggest the empirical testing of the Triple Helix Triangulation conceptual model as well as proposing new questions or hypotheses leading to the development of the model itself and a better alignment of the regional competitiveness perspective.

9. REFERENCES

- Arroyo-Vázquez, M., Sijde, P., & Jiménez-Sáez, F. (2009). Innovative and creative entrepreneurship support services at universities. *Service Business*, 4(1), 63-76. Doi:10.1007/s11628-009-0084-4.
- Audretsch, D. B., Hülsbeck, M., & Lehmann, E. E. (2011). Regional competitiveness, university spillovers, and entrepreneurial activity. *Small Business Economics*. Doi:10.1007/s11187-011-9332-9
- Baltzopoulos, A., & Broström, A. (2011). Attractors of Entrepreneurial Activity: Universities, Regions and Alumni Entrepreneurs. *Regional Studies*, (December), 1-16. Doi:10.1080/00343404.2011.602335
- Bathelt, H., Kogler, D. F., & Munro, A. K. (2010). A knowledge-based typology of university spin-offs in the context of regional economic development. *Technovation*, 30(9-10), 519-532. Doi:10.1016/j.technovation.2010.04.003
- Bramwell, A., & Wolfe, D. A. (2008). Universities and regional economic development: The entrepreneurial University of Waterloo. *Research Policy*, 37(8), 1175-1187. Doi:10.1016/j.respol.2008.04.016
- Budd, L., & Hirmisf, K. (2004). Conceptual Framework for Regional Competitiveness. *University Business*, 3(December), 1015-1028. Doi: 10.1080/tl034340042000292
- Cooke, P. & Leydesdorff, L. (2006). Regional Development in the Knowledge-Based Economy: The Construction of Advantage. *Journal of Tecnology Transfer*, 31: 5-15, 2006.
- Dinapoli, T. P. (2011). The Economic Impact of Higher Education in New York State. *New York*, 1-4.
- Eom, B.-Y., & Lee, K. (2010). Determinants of industry–academy linkages and, their impact on firm performance: The case of Korea as a latecomer in knowledge industrialization. *Research Policy*, 39(5), 625-639. Doi: 10.1016/j.respol.2010.01.015
- Etzkowitz, H. (2003a). Innovation in Innovation: The Triple Helix of University-Industry-Government Relations. *Social Science Information*, 42(3), 293-337. Doi: 10.1177/05390184030423002

- Etzkowitz, H. (2003b). Research groups as “quasi-firms”: the invention of the entrepreneurial university. *Research Policy*, 32, 109-121.
- Etzkowitz, H. (2008). *The Triple Helix: University–Industry–Government Innovation in Action*. New York, Routledge. Doi:10.1080/09537320802426309
- Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university – industry – government relations. *Science and Technology*, 109-123.
- Etzkowitz, H., & Dzisah, J. (2008). Rethinking development: circulation in the triple helix. *Technology Analysis & Strategic Management*, 20(6), 653-666. Doi: 10.1080/09537320802426309
- Galindo, P. V., Vaz, T. D. N., & Nijkamp, P. (2011). Institutional capacity to dynamically innovate: An application to the Portuguese case. *Technological Forecasting and Social Change*, 78(1), 3-12. Doi: 10.1016/j.techfore.2010.08.004
- Garrido-Yserte, R., & Gallo-Rivera, M. T. (2008). The impact of the university upon local economy: three methods to estimate demand-side effects. *The Annals of Regional Science*, 44(1), 39-67. Doi: 10.1007/s00168-008-0243-x
- GEM. (2007). *Global Entrepreneurship Monitor- Projecto GEM Portugal 2007*. SSRN *Electronic Journal*.
- Gopalakrishnan, K., Yusuf, Y., Abubakar, T., & Ambursa, H. M. (2012). Sustainable supply chain management: A case study of British Aerospace (BAe) Systems. *International Journal of Production Economics*. doi:10.1016/j.ijpe.2012.01.003
- Grant, R. M. (1991). Porter’s “competitive advantage of nations”: An assessment. *Strategic Management Journal*, 12(7), 535-548. Doi:10.1002/smj.4250120706
- Harris, J. D., Sapienza, H. J., & Bowie, N. E. (2009). Journal of Business Venturing Ethics and entrepreneurship ☆. *Ethics*, 24, 407-418. doi:10.1016/j.jbusvent.2009.06.001
- Huahai, L., Xuping, Z., & Feng, Z. (2011). Regional Innovation System Efficiency Evaluation Based on the Triple Helix Model. *2011 International Conference on Business Computing and Global Informatization*, 154-157. Doi: 10.1109/BCGIn.2011.46
- Kelley, D. J., Singer, S., & Herrington, M. D. (2011). *Global Entrepreneurship Monitor 2011. Global Report*.
- Kim, Y., Kim, W., & Yang, T. (2011). The effect of the triple helix system and habitat on regional entrepreneurship: Empirical evidence from the U.S. *Research Policy*. 10.1016/j.respol.2011.08.003

- Kirkwood, H. (2010). Challenges in Collection Development for Entrepreneurship. *Journal of Business & Finance Librarianship*, 15(3-4), 220-220. Doi: 10.1080/08963568.2010.490056
- Leydesdorff, L. (2011). The Triple Helix, Quadruple Helix, ..., and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy? *Journal of the Knowledge Economy*. Doi: 10.1007/s13132-011-0049-4
- Leydesdorff, L., & Meyer, M. (2006). Triple Helix indicators of knowledge-based innovation systems Introduction to the special issue. *Research Policy*, 35(10), 1441-1449. Doi: 10.1016/j.respol.2006.09.016
- Lundberg, H., & Andresen, E. (2011). Cooperation among companies, universities and local government in a Swedish context. *Industrial Marketing Management*. Doi: 10.1016/j.indmarman.2011.06.017
- McAdam, R., Miller, K., McAdam, M., & Teague, S. (2011). The development of University Technology Transfer stakeholder relationships at a regional level: Lessons for the future. *Technovation*, 1-11. Doi: 10.1016/j.technovation.2011.08.001
- MacGregor, S. P., Marques-Gou, P., & Simon-Villar, A. (2010). Gauging Readiness for the Quadruple Helix: A Study of 16 European Organizations. *Journal of the Knowledge Economy*, 1(3), 173-190. Doi: 10.1007/s13132-010-0012-9
- Martin, F. (1998). The economic impact of Canadian university R&D. *Research Policy*, 27(7), 677-687. Doi: 10.1016/S0048-7333(98)00083-3
- Nijkamp, P. (2003). Entrepreneurship in a Modern Network Economy. *Regional Studies*, 37(4), 395-405. Doi: 10.1080/0034340032000074424
- Nordqvist, M., & Melin, L. (2010). Entrepreneurial families and family firms. *Entrepreneurship & Regional Development*, 22(3-4), 211-239. Doi: 10.1080/08985621003726119
- Porter, M. E., & Stern, S. (2001). Innovation : Location Matters. *MIT Sloan Management Review*. Summer 2001; 42(4), 28-36.
- Porter, M. E., & Kramer, M. R. (2006). Strategy and Society: the link between competitive advantage and corporate social responsibility. *Harvard Business Review*, 6 (December).
- Potts, T. (2010). The natural advantage of regions: linking sustainability, innovation, and regional development in Australia. *Journal of Cleaner Production*, 18(8), 713-725. Doi: 10.1016/j.jclepro.2010.01.008

- Salvador, E. (2010). Are science parks and incubators good “brand names” for spin-offs? The case study of Turin. *The Journal of Technology Transfer*, 36(2), 203-232. Doi: 10.1007/s10961-010-9152-0
- Semlinger, K. (2008). Cooperation and competition in network governance: regional networks in a globalised economy. *Entrepreneurship & Regional Development*, 20(6), 547-560. Doi: 10.1080/08985620802462157
- Schumpeter, J.A, 1942. *Capitalism, Socialism and Democracy*. New York , Harper and Row.
- Schwab, K. (2010). *The Global Competitiveness Report 2010–2011*. Forum American Bar Association.
- Smith, H. L., & Bagchi-Sen, S. (2010). Triple helix and regional development: a perspective from Oxfordshire in the UK. *Technology Analysis & Strategic Management*, 22(7), 805-818. Doi: 10.1080/09537325.2010.511143
- Turok, I. (2004). Cities, Regions and Competitiveness. *Regional Studies*, 38(9), 1069-1083. Doi: 10.1080/0034340042000292647
- Van Looy, B., Landoni, P., Callaert, J., van Pottelsberghe, B., Sapsalis, E., & Debackere, K. (2011). Entrepreneurial effectiveness of European universities: An empirical assessment of antecedents and trade-offs. *Research Policy*, 40(4), 553-564. Doi:10.1016/j.respol.2011.02.001
- Viale, R., & Etzkowitz, H. (2010). The Capitalization of Knowledge: A Tripla Helix of University-Industry-Government. (R. Viale & H. Etzkowitz, Eds.) (1st ed., p. 351). Cheltenham, UK: Edward Elgar Publishing.
- Wong, P. K., Ho, Y. P., & Autio, E. (2005). Entrepreneurship, Innovation and Economic Growth: Evidence from GEM data. *Small Business Economics*, 24(3), 335-350. Doi: 10.1007/s11187-005-2000-1
- Yusuf, S., & Nabeshima, K. (2007). *How Universities Promote Economic Growth. Human Development*. The international Bank for reconstruction and development/The World Bank. Washington DC, 2007.