Advances in Business-Related Scientific Research Conference 2016 in Venice
(ABSRC 2016 Venice)
March 17-18, 2016, Venice, Italy

A NEW FRAMEWORK FOR STUDYING NATIONAL INNOVATION SYSTEMS, WITH THE CASE OF CROATIA IN THE ADRIATIC REGION CONTEXT

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Abstract

This paper aims to identify, classify and analyze the innovation chain of enablers and inhibitors in Croatia in the context of the Adriatic Region. To this end, we present a series of indicators across ten innovation dimensions that constitute an important and integral part of a national innovation system, and which were previously compiled by the PACINNO project consortium. Another important objective of the study is the evaluation of the Croatian national innovation system and innovation policies. Here we rely on the qualitative data obtained through interviews with key informants, identifying the role of the system components as innovation enabling or inhibiting. This research contributes to the literature on national and regional innovation systems by providing the first comprehensive set

of data focusing on the Adriatic Region and novel analytical framework for the study of national and regional innovation systems.

Keywords: innovation, enablers, inhibitors, Adriatic Region

Topic Groups: Technology and innovation management, Politics and business, Macroeconomics

INTRODUCTION

The main objective of this paper is to identify, classify and analyze the components of the innovation chain of enablers and inhibitors in Croatia in the specific context of the Adriatic Region, considering their critical role in the generation and growth of high-tech innovative enterprises. To this end, we present a range of indicators across ten dimensions that constitute a national innovation system, based on the data which were previously compiled by the IPA Adriatic Cross-border Cooperation PACINNO project consortium. These dimensions include human resources, education system, public and private sector, funding, linkages, entrepreneurship and SME, scientific output, economic data and, finally, institutions. Another important objective of our study is the evaluation of Croatian national innovation policies and national innovation system. This refers to the assessment of the structure and level of coordination of policy making, policy execution and intermediary institutions, in terms of identifying their role as innovation enabler or inhibitor. Finally, taking into consideration the fact that the majority of innovation research and literature is focused exclusively on innovation enablers, our objective is to focus also on the innovation inhibitors which play a crucial role in the national innovation system and must not be ignored. Therefore, our aim is to assess and identify the status of ten aforementioned dimensions as innovation enablers and/or inhibitors.

This research builds on an empirical study conducted under the IPA Adriatic Cross-border Cooperation project PACINNO in the period 2014-2015. Although the data have been collected simultaneously for eight countries of the Adriatic region, the focus of this paper is put on Croatia in order to grasp its territorial specificity with respect to our research subject.

THEORETICAL FRAMEWORK

Conceptualization of innovation systems: literature review

In the attempt to understand the interplay between various actors and processes that have the role of enablers or inhibitors of innovation, Peixoto (2011) deploys the framework of the structuration theory, originally put forward by Giddens (1979). Structuration theory conceptualizes social structure as a dynamic interplay of its structuring properties. The author argues that these properties can be understood as “rules and resources, recursively implicated in the reproduction of social systems” (Giddens, 1979, p. 235). Structure can be understood as both, a constraint and an enabler of interaction. From this broader sociological perspective, it is clear that the concept of social system has a certain structure

which then serves as an enabler or an inhibitor of interaction, by means of internal or external drivers (Peixoto, 2011).

Innovation, defined as "new creations of economic significance" (Edquist, 2001) can be viewed as a form of social interaction, whether between actors or between an actor and the system.

Any type of social interaction cannot happen if detached from the social system that created, regulated and hosted that interaction. The same analogy can be used for the process of innovation in an innovation system. In this line of thought, many authors emphasize the dynamic properties (Carlsson, Jacobsson, Holmén, & Rickne, 2002) and dynamic complexity (Sterman, 2001) of the system which arises because systems are constantly changing, nonlinear, and adaptive. T.-L. Lee & von Tunzelmann (2005) have also embraced this dynamic perspective emphasizing the interrelation between features of the system which generates structure which in turn moderates and produces certain behaviours.

Based on the above elaborated theoretical approaches this paper adopts the perspective of a system in which system components, relationships and attributes provide rules and resources that serve as enablers or inhibitors of innovation.

A spatial perspective on innovation systems

The deployment of territorial context in the studies of innovation systems gained significance among scholars and policy makers as an integral part of their analytical perspective after the discussions on industrial policy in the mid-1980s in Europe (Sharif, 2006), when the concept of national innovation system (NIS) emerged.

Freeman (1987, as cited in OECD (1997)) defines NIS as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies". Lundvall (1992) conceptualized NIS in its narrow and broad scope: narrow including organizations and institutions involved in searching and exploring – such as R&D departments, technological institutes and universities, and the broad concept including "all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring – the production system, the marketing system and the system of finance, which present themselves as sub-systems in which learning takes place" (Lundvall, 1992).

In order to understand the concept of NIS, it is necessary to take into account its complexity, as the system consists of a multitude of sub-systems, and can be classified according to each individual sector and region. This leads to the concept of regional innovation system (RIS).

The emergence of regional clusters, along with the increase of regional innovation policies, is responsible for the growing popularity of the concept of RIS. Albeit there is no generally accepted definition of RIS, Chung (2002) defines the concept as a set of „innovation actors and institutions in a region that are directly related

with the generation, diffusion, and appropriation of technological innovation and an interrelationship between these innovation actors".

However, an underlying problem in all RIS studies, as Doloreux & Parto (2005) point out, is the difficulty to determine how regional innovation system should look like in reality, and what actually constitutes a regional innovation system.

Towards the typologies of innovation systems through the lens of enablers and inhibitors

The question of evaluation and comparison of national, regional and sectoral innovation systems according to their performance has attracted significant attention in the literature. Following Bresnahan & Trajtenberg (1992), Rodríguez-Pose (1999) states that various social conditions (political, institutional, etc.) lead to a different environment for innovation, creating two clusters: innovation prone and innovation averse societies. The level of technological learning is connected to local social conditions that serve as a "social filter" which determines the rate at which society adopts innovation and transforms it into real economic activity (Rodríguez-Pose, 1999, p. 81).

Herrera & Nieto (2008), recognizing that each region is marked by different preconditions for innovation, make a distinction between central and periphery regions. Following this path, Cooke, Gomez Uraga, & Etxebarria (1997) also argue that there are regions showing more or less favourable conditions for their establishment as regional innovation systems

Innovation can build upon (1) internal knowledge of the region, (2) local creativity which profits on the account of knowledge acquired elsewhere and (3) local innovation imitation (Capello & Lenzi, 2013). In the third instance, these regions need to be territorially attractive, with large final market, competitive labour cost, spatial proximity (B. T. Asheim & Coenen, 2005; Carlsson, 2006) and the ability to capitalize on spillovers (Crescenzi, Rodriguez-Pose, & Storper, 2007). The complex interplay of different innovation phases and spatial context is the essence of the paradigm of territorial patterns of innovation.

Spatial proximity represents an especially popular determinant (though not necessarily an enabler) of an effective knowledge spillover and/or adaptability pattern in numerous studies, for its ability to transfer tacit knowledge, and informal types of interaction (B. Asheim, Coenen, & Vang, 2005; Carlsson, 2006).

Specificities of the innovation eco-system of the Adriatic Region

The particular setting of the Adriatic Region has so far received limited attention in the empirical studies of national and regional innovation systems, despite its increasing strategic importance, recognized through the adoption of various policy documents (e.g., European Union's Strategy for the Adriatic and Ionian Region (EUSAIR)). Furthermore, the European Union mission strongly supports strengthening and enabling the cooperation in the region, also in the light of facilitating the non-EU member countries in their accession to the European Union

and inclusion of the countries in the European Research Area (Marinkovic & Dall, 2014).

Although countries of the Adriatic Region are not a homogenous group, they do have common challenges, which is the main argument in favour of tackling their issues on the regional level. In economic terms, this region is characterized by transition economies, which has left a deep impact on the countries in terms of lagging behind the rest of the EU countries. Particular economic situation in this region (excluding Italy and partly Slovenia) is a result of several events in the recent history, including warfare, transition process political situation and global financial crisis. One of the consequences of the war events during the 90s was the migration of many scientists, engineers and other highly skilled personnel, which left disastrous consequences in the field of science, compromising research capacity of this region for many upcoming years (Radosevic, 2004; World Bank, 2013). For example in Croatia, the number of researchers decreased by 25% in the past decade (Švarc et al., 2014).

The analysis of factors that positively and/or negatively affect the innovation system is crucial in order to formulate concrete proposals for the improvement of innovation performance and competitiveness of the Adriatic Region.

METHODS

The empirical part of the study builds on the data collected by the consortium of the PACINNO project. For the purpose of this study, two types of data were utilized: quantitative and qualitative.

Quantitative analysis

The data for the quantitative part of the research were identified following the review of empirical studies on national and regional innovation systems and screening of various international (EUROSTAT, World Bank, Total Economy Database, Innovation Union Scoreboard, OECD, Global Innovation Index, EU CORDIS, eCORDA, Global Entrepreneurship Monitor, SCImago) and national databases. A total of 226 variables were pre-selected and categorized into 10 groups or dimensions to facilitate interpretation of results, namely: *economic data, human resources, education system, public sector, private sector, funding, linkages, entrepreneurship & SMEs, scientific output and institutions*. The participating partners from eight countries of the Adriatic Region simultaneously collected the data available for their countries in the period from July to November 2014.

A significant portion of the data for non-EU countries of the Adriatic Region could not be collected due to their non-availability in any of the databases or local statistics offices. This resulted in the final selection of 37 indicators which are included in this analysis.

Qualitative analysis

In order to validate the results of the quantitative study and deepen our understanding of the Croatian innovation system, its structure and dynamics in the

context of the Adriatic Region, semi-structured interviews were conducted with eight key informants, selected by the reference based method and snowball method (Patton, 1990) and lasting overall 385 min, on average 55 mins per interview. The final sample comprised four main groups of respondents: Croatian entrepreneurs, policy makers, academics and intermediaries. The interviews were conducted in the period from June – October 2015.

Semi-structured interviews were selected because they allow the interviewer to pursue unexpected paths introduced by the interviewee and to encourage discussion by probing (Neergaard & Ulhoi, 2007), at the same time having a structure that enables comparison across cases. The interviews were conducted to the point of saturation of answers (Kvale, 1996)[1]. Two pilot interviews were also conducted with the aim of testing the clarity and appropriateness of questions comprised within the interview guide. The interview guide was prepared on the basis of the review of literature and reports on innovation systems and innovation policy.

The interviews were conducted face to face and both sides signed the consent form (Kvale, 1996; Yin, 2011) which contained information about the interview structure and confidentiality provisions. The anonymity was ensured also by coding of respondents' names in all interview-related materials. The interviews were audio recorded and written summaries were extracted from the recordings as a basis for data analysis. The interviews were coded, transferred into the Atlas.ti software and analysed using the "ad hoc creation of meaning" method, which enables the researcher to constantly adapt analysis techniques with regard to changing circumstances (Kvale, 1996).

FINDINGS

Quantitative findings

Here we present the most important findings per each dimension.

[1] The saturation of answers in qualitative interviews is highly debatable. For example, Kvale (1996) recommends doing at least 15 interviews, while Guest et.al. (2006) clearly relate saturation with the homogeneity of the sample.

Table 1: Innovation system indicators across 10 dimensions: comparison of Croatia with the Adriatic Region

DIMENSION	ABOVE ADRIATIC REGION (AR) AVERAGE	CRO	AR	BELOW ADRIATIC REGION (AR) AVERAGE	CRO	AR
1. ECONOMIC DATA	Unemployment rate	15,67%	18,20%	GDP per capita (EUR)	10.196,14	12.682,14
	Total Exports (% of GDP)	42,08%	34,57%	GDP real growth rate	-1,10%	7,09%
	Current account deficit (% of GDP)	-0,10%	-6,88%			
2. HUMAN RESOURCES	New PhD graduates (% of active population	0,05%	0,03%	Total R&D personnel(% of active population)	0,59%	0,82%
				Total researchers (% of active population)	0,23%	0,33%
3. EDUCATION SYSTEM	Population with tertiary education (% of active population)	0,18%	0,17%	University expenditures in R&D (% of GDP)	0,20%	0,49%
	Quality of education index	471	448,6			
4. PUBLIC SECTOR	Government expenditure in R&D (% of GDP)	0,21%	0,19%	Public R&D on applied research (% of GDP)	0,07%	0,13%
	Public R&D on basic research (% of GDP)	0,13%	0,06%	Public R&D on experimental development (% of GDP)	0,01%	0,02%
5. PRIVATE SECTOR	R&D performed by the business sector on basic research (% of GDP)	0,07%	0,08%	Business expenditures in R&D in the country (% of GDP)	0,37%	0,77%
				Share of innovative SMEs	67,80%	79,30%
6. FUNDING	Ease of getting credit index	66,80	63,31	Gross R&D expenditure in the country (private sector) - % of GDP	0,31%	0,63%
				Gross R&D expenditure in the country (public sector) - % of GDP	0,35%	0,61%
				Domestic credit(private sector)	70,63%	77,03%

7. LINKAGES	Percentage of patent co-authorship EPO (application)	45,80%	25,30%	Share of scientific publications with at least 1 foreign co-author	31,50%	45,23%
				Share of innovative firms with national and international collaboration for innovation	15,44%	23,93%
8. ENTREPRENEURSHIP & SMEs	No indicators above AR average			Newly established companies (% of active population)	0,47%	0,60%
				Adult population(new entrepreneurs) (% of active population)	2,00%	2,59%
				Bankruptcies (% of active population)	0,78%	0,72%
9. SCIENTIFIC OUTPUT	SCIMAGO scientific journal articles (% of active population)	0,21%	0,19%	Citable documents H index	161,00	188,43
				WIPO patent applications (% of active population)	0,01%	0,05%
				WIPO trademark fillings (% of active population)	0,15%	0,57%
10. INSTITUTIONS	Ease of starting a business index	84,79	84,18	Ease of resolving insolvency index	31,78	46,23
	Ease of paying taxes index	77,43	64,34	Ease of protecting investors index	46,67	56,19
	Political stability index	79,67	67,23			
	Government effectiveness index	56,73	44,82			

Economic data suggests that Croatia stands better than the Adriatic Region (AR) regarding the total exports (% of GDP), unemployment rate and current account deficit (% of GDP), while GDP per capita and GDP real growth rate are indicators which place Croatia below AR's average value. New PhD graduates (% of active population) are the only indicator placing Croatia above AR average, while in the same dimension of *Human Resources*, total R&D personnel (% of active population) and total researchers (% of active population) are below AR average. In the *Education system*, Croatia has larger percentage of active population with tertiary education and higher quality of education index, even though university expenditures on R&D (% of GDP) are below average. Croatian government expenditures on R&D (% of GDP) and Public R&D on basic research (% of GDP) are above average, while AR excels in public spending on applied research (% of GDP) and experimental development (% of GDP). Croatia has higher share of R&D performed on basic research in the business sector (% of GDP), but lags behind the AR in business expenditures in R&D in the country (% of GDP) as well as in the share of innovative SMEs. The dimension of *Funding* puts Croatia above the AR only in the ease of getting credit index, while all the other indicators are below AR's average. *Linkages* dimension is not different, where the percentage of patent co-authorship (EPO applications) is above AR's average, while all of the other indicators place Croatia below the Region's average. *Entrepreneurship & SMEs* is the only dimension in which by every indicator Croatia stands below AR average. Regarding the *Scientific output*, Croatia surpasses the Region in SCIMAGO scientific journal articles (% of active population) but lags behind in citable documents H index, WIPO patent applications (% of active population) and trademark fillings (% of active population). Probably the best dimension for Croatia is the *Institutions* dimension, where Croatia scores higher than AR in ease of starting a business and paying taxes indexes and has higher political stability and government effectiveness index. Adriatic Region was indexed better in ease of resolving insolvency and ease of protecting investors.

Qualitative findings

In terms of evaluation of innovation systems and policies, substantial differences in the views of different stakeholders have been identified in literature (Massa & Testa, 2008).

The general system of innovation in Croatia has been developing since 2001 and in the early phases the implementation and the design were presented as a best practice in the Region as well, as noted by the experts: „*When we implemented the system in the beginning, we were a role model for other countries in the region. I know that Serbia as well as Albania tried to copy our system.*"

Best practices in the innovation policy

Almost all the experts identified two main best practices in Croatia: Proof of Concept (PoC) measure implemented by the main state innovation agency at the time (BICRO), which was actually a copy of foreign measure that seems to have functioned pretty well in the Croatian environment. However, when talking about the impact and the successfulness of the strategy, the experts did not fully agree.

The second practice that was identified as best practice by the majority of experts was the tax incentive measure for R&D investments of the private sector. Most experts found it quite successful and accepted measure on the market, however experts debated on the scale of the overall impact on the R&D activity increase.

In general, opposite opinions rose on the issue of the impact the implemented measures had: some regard them as highly successful due to the large pool of funded projects, others complain that the aim of the policy had not been achieved and that the continuity of the certain measures was questionable due to the general lack of funding and the system changes that happened with the merging the innovation agency with the agency for SMEs, in that way losing the direction and focus on the subject of innovation.

Inhibitors of the Croatian innovation system

The main inhibitors identified by the experts can be classified into two groups: internal and external factors. When talking about the internal characteristics of the system, the interviews showed two main obstacles: poor management and lack of coordination as well as the lack of strategy and strategic perspective. All of the experts agree that there is no coordination and no cooperation between the actors and in addition, identify the third main obstacle which is the lack of political will for changes:

"There is no coordination body, no action plan; no deadlines with specific activities, there are no funding sources identified, nothing that we could deal with."

Since the precondition for better management needs to be better coordination at the state level, the lack of political will is the next obstacle most often pointed out. Experts describe this problem as a main blocker of any activity that could positively influence innovation, which is a good perspective on the system present in Croatia: *"Everybody knows what can be done, but there is no political will to do it. Research results show, results from the OECD analysis, EU Commission analysis, national research and analysis show that by investing in R&D you raise the quality of life and the GDP. It is the Bible. But the politics in Croatia do not recognize this."*

The mentioning of the apathy and the non-existence of the normative potential for changes is also reflected in two other inhibitors that we identified: the cultural problem and the lack of cooperation between actors. In this sense, the experts clearly identify the internal struggles present on the meetings, the general feedback aversion, the fear of criticism and outdated communication practices in some ministries, making the decision making process and delivering feedback even more cumbersome.

There was disagreement between the experts' opinion on whether or not the aims of the policies were well defined or if they existed at all, which shows the general lack of strategic perspective on what has to be done.

The biggest identified external obstacle is the general lack of funding. The major historical impact was the World Bank projects, and now the government is oriented

towards the European funds. Lack of funding was also mentioned as one of the obstacles in implementation of measures.

The enablers of the Croatian innovation system

The main identified enablers were: the entrance in the European Union and the availability of EU funds as well as the knowledge and the supervision coming from the foreign consultants. All the experts agree that without further funding, the amount allocated from the state budget cannot provide the changes and the support the innovation system needs.

The main positive trends that could positively influence the environment besides entering the European Union is the presence of an entrepreneurial model, that is also evident in the orientation of the latest European Union research funds in HORIZON 2020 program and some the of newly established measures in Croatia (Entrepreneurial Impulse).

DISCUSSION

By identifying innovation enablers and inhibitors we are able to assess the current innovation climate on the territory of Croatia. Better knowledge about the innovation chain of enablers and inhibitors will create a new foundation for the innovation policies and therefore potentiate the creation of a more entrepreneurship and innovation friendly environment in Croatia. Thus, the main contribution of this paper is in the generation basis for the specific propositions for the development of innovation policies to policy makers as well as pointing out the factors that could stimulate innovative activities and contribute to the creation of favourable innovation climate. Furthermore, the literature and relevant international sources do not contain all the relevant data for Croatia, which is the added value of our research efforts, in addition to presenting a new perspective on the existing data.

Taking into account different macroeconomic and demographic data such as GDP, total population, export, GDP per capita etc., one can say that Croatian economy underperforms and still lags behind the regional average. Indicative in this manner is the lack of coordination of the institutions as well as the political will for change, evident from the results of the interviews. More specifically, and in line with the previous data, Croatia still lags behind the region in total R&D personnel, universities spend less on R&D, and Croatia is performing worse in almost every sector of science. One of the most important indicators in which regional means are higher than Croatian are related to linkages, which is also a consequence of a poor infrastructure and cultural inhibitors that need time, funds and political will to be addressed appropriately. Furthermore, the identified lack of institutional coordination and overall complicated bureaucracy in addition to non-friendly entrepreneurial culture seem to have a negative effect on the number of newly established companies, new patent applications and in general the "…penetrating state of mind", as depicted by one of the respondents.

As shown in the results of the analysis, major obstacles in the Croatian Innovation System have to be addressed on the highest level of authority. The general problem

of poor direction and management has to do with the remains of the socialist political system and the general lack of skills and capacities in the state administration to employ a healthy policy development system – one that is following scientific principles, evaluating and learning from the past experiences as well as consolidating and working on the common goals and interest of the society.

In addition to all noted above, there are some indications of good practice and indicators that show some degree of potential. Croatia is ahead of the regional average in share of new PhD graduates and population with completed tertiary education. Furthermore, the quality of education is greater than the regional mean and Croatia has higher percentage of patent co-authorship (EPO applications). All this represents a good starting point and background for further advancement of the innovation process and economy as a whole.

The Croatian participation in the European Union has been identified as a significant enabler in the sense of providing the knowledge and forcing the systemic thinking and strategic approach to the allocation of the state resources as well as qualifying for the EU funds.

CONCLUSIONS AND IMPLICATIONS

In this paper we presented ten important innovation dimensions which form an integral part of a national innovation structure. As such, the paper provides a new approach for understanding the factors that determine specific innovation climate in Croatia, and the Adriatic Region. Taking into account that countries of this region have relatively modest innovation capacity, the identification of innovation enablers and inhibitors enabled us to detect the factors that actually spur and hamper the development of the innovation system in this region.

The evaluation of the aforementioned innovation dimensions has shown, among other things, that although these countries share common challenges, they are not a homogeneous group, and thus, the implementation of knowledge-based economy is dependent on specific characteristics of each country. Innovation environment should, therefore, be studied in the broader sense, primarily in the fields of culture and social institutions that are not strictly of economic background, and therefore, could not be tackled within this study.

One of the fundamental problems of the Adriatic Region, in terms of innovation, is a substantial lack of strategy and regulatory framework, resulting in mainly non-existent long term cooperation between research institutions and industry, as well as the poor performance in technology transfer.

In order to inspire the creation of a more entrepreneurship-and-innovation-favourable environment in the region, priority should be given to the generation of the specific propositions for the development of innovation policies to policy makers and pointing out the factors that could stimulate innovative activities and contribute to the creation of favourable innovation climate.

Finally, since Adriatic Region has not received sufficient attention in the empirical studies of national and regional innovation systems, as well as the literature and relevant international sources, the intention of this paper was also to fill that gap.

ACKNOWLEDGMENTS

This research was supported by the IPA Adriatic Cross-border Cooperation Programme; project "Platform for trans-Academic Cooperation in Innovation – PACINNO" (str/0003). The authors acknowledge the contribution of all partners in the PACINNO consortium in the quantitative data collection process for each country of the Adriatic Region. The authors also thank Prof. Dr. Stipan Jonjic for valuable help in approaching the respondents for the qualitative part of the study.

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