Strategic Factors Influencing National and Regional Systems of Innovation: A Case of Weaker NSI with Stronger RSI

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ABSTRACT

The issues of relationship between NSI ((National System of Innovation) and RSI (Regional System of Innovation) are not well reported with innovation policy research. That is, whether the NSI is the system on top of RSI, or the importance of regions make stronger NSIs. Therefore, it raises concern regarding development of strategic relationship between these two. For this, two cases – Catalonia (Spain) and N Ireland (the UK), have been selected based on theoretical sampling. Key economic indicators have been identified and have been quantitatively analyzed. The evidence suggests that strong NSI has positive influence on RSI. In addition to that, the concentration of knowledge and promotion of institutions may be strategically established and then needed resources may be injected to produce high quality human resources. There is, however, need for more comprehensive studies to be conducted in order to validate the results of this research.

Key Words: **Innovation, National System of Innovation, Regional System of Innovation, Catalonia, Northern Ireland.**

1. INTRODUCTION

Development and growth of any country is largely dependent upon the establishment of institutions for the generation of knowledge and then appropriately linking of the institutions with industries, i.e. users of knowledge. This stresses the importance of national and regional systems of innovation (Niosi, [1]). According to different definitions, both converge on the idea of interacting organizations and institutions for the development of science and technology (Freeman, [2]; Cooke, [3]). These institutions in collaboration with other actors (e.g. firms, universities, public laboratories, etc.) become innovative partners (Rashdi, et. al., [4]).

For any countryto grow and prosper, national system is one of the most contributing factors (Rashdi and Rashdi, [5]). Most developed nations, however, have developed a system where regions are important elements towards the progress of nations, such as EU (European Union). It is, also, well documented that, within industrial nations, only few regions concentrate on most of national institutions devoted to the development of industrial innovation (Cooke, [3]). This is due to the fact that every nation is comprised of regions which are ranged from very strong or very weak (peripheral); such as London and West Wales, respectively, in the UK. It, therefore, creates an

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argument about the influence of national system (of innovation) over their regional system (of innovation).

In order to understand this influence, somehow, it is advisable that key influential national and regional indicators need to be studied (Evangelista, et. al., [6]). For that, key input and output indicators are selected via reviewing the relevant literature (Corvers, [7]). The main focus of this research, hence, will be to determine the strategic factors that influence relationship between 'national system of NSI and RSI.

Section 2 presents some basic definitions, the theoretical framework. In this section the focus will be turned towards the topic i.e. 'National versus Regional Systems of Innovation' and the strategic relationship between them and hence strong and weak NSI and RSI. The important input and output indicators are selected via relevant literature. In section 3 research methodology adopted for this research is discussed. In section 4 the results are analyzed. The next section discusses the key findings from the results. Limitations and Suggestion for future directions are posed in the next section. Finally, in section 7 conclusions and suggestions are given.

2. NSIs AND RSIs

The concept of NSI was given in the 1980s; whereas, the RSI was studied in the 1990s. Freeman [2], Lundvall [8], Nelson and Rosenberg [9], etc., developed the concept of NSI, whereas Cooke [3] and Cooke and Morgan [10], etc., studied RSIs.

2.1 National System of Innovation

The idea of 'national' system for competitive performance can be traced back to 1841 when German economist Friedrich List wrote his highly nation-state-oriented National Systems of Political Economy (de la Mothe and Paquet, [11]). But the broad definition of NSI was firstly proposed by Freeman [2], as the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technology. Lundvall [8] went on to define NSI in both broad and narrow sense. It was narrowly defined as "organizations, institutions involved in searching and exploring- such as R&D (Research and Development) departments, technological institutes and universities". Broadly, however, it is defined as "all parts and aspects of institutional set-up affecting learning as well as searching and exploring".

In the embryonic stages, large population was skeptical about the diffusion of innovation system; until recently they become crucial components of the policy making. One reason for this important position within national economy was the failure of both macroeconomic theory and policy to understand and control the factors behind international competence (Lundvall, [12]).

2.2 Regional System of Innovation

The world, recently, is changing rapidly as a global village -particularly because of the rapid increase in the use of ICT (Information and Communications Technology) - where regions are gaining increasing importance. Moreover, the heterogeneity of cultures, habits and norms within a country or state, and the concentration of knowledge and skills within certain areas, have largely contributed towards importance of regions within an economy. Howells rationalizes this as 'the national unit may be too broad a category … instead focus should be on a number of technology-based system each of which is geographically and institutionally localized within the nation' (Howells, [13]).

The concept of RSI is relatively new in comparison to NSI. Many authors put lot of efforts to give a better understanding of both concepts. When economic development is under discussion, it apparently indicates the quality of life of citizen dwelling in the certain area. The evidence shows that the more the economy is knowledge-based, the more prosperous are regions or nations and their citizens (Mosey et. al., [14]). It was reviewed that knowledge is likely to be more embedded in sub-national unit than equally spread of the national level (Cantwell and Iammarino, [15]). This does not give absolute importance that regions or RSIs is making the nations or even undermine the importance of NSIs. Nevertheless, due to its special characteristics within knowledge based economy, it is essential to give more detail to RSIs for the diffusion and transfer of knowledge and technology.

2.3 'Strong' and 'Weak' National Systems

There are no certain parameters to identify a national system as strong or weak. However, one can get the idea of either strong or weak national systems from various performance indicators, such as GDP (Gross Domestic Product) per capita, employment, number of

patents, the publications, investment in private and public R&D, quality of life of citizens, services provided to the citizens, and quality of education. Corvers [17] opined that there are four dimensions to measure the performance of a system:

(i) Research Capacity- i.e. the number of scientists and engineers working in organizations such as firms; investment in R&D; etc.
(ii) Social and Human Capital- i.e. percentage of GDP spent on education; percentage of population with tertiary education qualification; etc.
(iii) Technological and Innovative Performance- i.e. the amount of R&D performed by the industry BERD (Business Expenditure on Research and Development) as a % of GDP); number of patents per capita; etc.
(iv) Absorption Capacity- i.e. the capacity of firms to renew product ranges; improvement in labor productivity; overall trade performance; etc.

2.4 'Strong' and 'Weak' Regional Systems

It might generally be presumed that strong regional systems lie in strong national systems and weak regional systems lie in weak national systems. However, this is not always the case, although the trend suggests this in the majority of cases; this is due to the concentration of knowledge in certain regions, making them stronger systems. Evangelista, et. al. [6] find evidence of R&D intensive regions and they opine that these regions are characterized by a good scientific and technological infrastructure due to high concentration of universities and public and private research institutions.

Morgan [16] is of the view that innovative regions often enjoy political autonomy, but it varies from country to country. For example, regions in Germany exploit potential to pursue more robust development strategies than in unitary states, where little or no institutional capacity for collective action exist at regional level. Cooke and Morgan [10], while defending the 'model region', identified following characteristics of regional systems:

- Technical excellence and quality products in key engineering industries and other mechanical engineering.
- Predominantly manufacturing-led growth economy with minimal role of service industries, such as banking.
- SMEs (Small and Medium Enterprises) linked to large firms through supply-chain relationships.
- Dense infrastructure of enterprise support organization such as Ministry of Economics, Chambers of Commerce and Industry, Regional Credit Banks, various government agencies, and public and private research institutes and consultancies.

2.5 Innovative Indicators

Corvers [7] suggests the following indicators for innovative activities:

(a) Input Indicators

- R&D expenditure by institutional sector;
- R&D personnel by institutional sector.

(b) Output Indicators

- Patent and high technology patent applications;
- Employment in high technology sectors;
- Innovation expenditure as percentage of turnover;
- Increase in market share due to new/improved products or introduction to new/improved processes;

There seem to be rather different conception of RSI, here; a broad is in the case of Cooke and Morgan [10], a narrower and more 'technical' in case of Corvers [7]. Evangelista et al. [6] found that firms located in the weak regions show weak technological performance:

- In terms of innovation strategies (clearly imitative in nature and oriented to the introduction of process innovation).
- Exhibit strong dependence on technologies generated outside the regional boundaries.
- Exhibit poor R&D capabilities.
- Lack support for public R&D facilities.

Besides that, many other indicators of performance such as employment, productivity and trade performance can help us characterize regional system as 'weak'.

3. METHODOLOGY

This is a case study research, based on the approach of Yin [17]. The cases are selected based on theoretical sampling, since the basic tenet of this research is to study the behavioral characteristics of two distinct regions in the context of European Union. The data is collected via 'Eurostat Year Book 2010' [18]. The data have consensual recognition in the world as it is collected and analyzed by the core working groups within EU.

Two distinct regions NUTS (Nomenclature of Territorial Units of Statistics) are Catalonia in Spain and Northern Ireland (N Ireland) in the UK are selected. There are interesting facts about the regions and nations in terms of their systems of innovation, which makes an interesting study to be explored. Within a relatively weaker NSI such as Spain, Catalonia is one of the strongest regions and, on the contrary, several evidences lead to conclude that N Ireland is one of the weakest regions in the strong UK NSI. The comparison is, initially, done within input and output indicators, and then across input and output indicators, selected for this study. Firstly, the input and output figures between two NSIs, i.e. Spanish NSI and the UK NSI are compared to find out the gap between two, taking EU27 (European Union Member States) as a benchmark. Similarly, the step is revised for the selected regions to assess the extent of any gap that actually exists. The innovation indicators are already explained in section 2.

Measuring competitiveness is not an easy matter and cannot be reduced solely to the notions of GDP, S&T (Science & Technology) infrastructure and R&D expenditure. Clearly, not all of these factors are readily measurable; moreover, they also include political, social and cultural parameters. However, since the focus here is on the relative competitive performance of the selected regions, the assumption can be made that these factors will have an identifiable effect on key economic measures.

4. ANALYSIS: THE COMPARISON OF SELECTED REGIONS AND NATIONS

4.1 Spain and the UK: The Input Indicators

The input indicators for Spain and the UK are given in Table 1, keeping EU27 indicators as a benchmark. Two of the indicators, i.e. GDP and persons at the risk of poverty are not the input indicators as mentioned in the earlier section of indicators. However, these indicators signify the quality of life in a country. Consequently, the healthy GDP per inhabitant and weak ratio of persons at the risk of poverty indicate, proportionally, a better quality of life in a country. From Table 1, both Spain and the UK exceed the EU27 in relationship to GDP per inhabitant. The UK, however, have significant edge when compared with the either Spain or EU27, i.e. the difference of 13 and 16 percentage points respectively. This shows the prosperity of country within the region (EU27). Similarly, the person at the risk of poverty give the UK, although not significant, nevertheless competitive edge over Spain (Table 1). The overall picture, however, reflect the UK a weaker area in comparison with EU27.

Expenditure on R&D as percentage of GDP, which is an important proxy for competitiveness, shows hypothetical trend as the UK spends more than Spain and little less than EU27 (Table 1). It is, however, a good omen for Spain that AAGR (Annual Average Growth Rate) is significantly larger than either the UK or EU27 (Fig. 1). This also reflects the efforts of Spain in getting on with Lisbon strategy for increasing the R&D to 3 percent. The target, although, way too difficult for any of the three selected entities, nevertheless, apparently looks easier for EU27 and the UK to make inroads, in comparison with Spain, with

TABLE 1. NATIONAL INPUT INDICATORS+

Input Indicators	EU27	Spain	UK
GDP per inhabitant in PPS(Purchase Power Standard) (EU27=100)	100	103	116
Persons at the risk of poverty (%)	16.5	19.6	18.8
R&D intensity (R&D expenditure as percentage of GDP)	1.90	1.35	1.88
Average Annual Growth Rate (AAGR) of R&D expenditure (2003-2008)	3.3	8.4	3.7
R&D expenditure by source of funds as a percentage of total			
Business enterprise sector expenditure as percentage of R&D	55	45	47
Government sector expenditure as percentage of R&D	34	44	30
Higher education sector expenditure as percentage of R&D	3	4	6
Profit and Non-Profit sector expenditure as percentage of R&D	9	7	18
R&D personnel HC(Head Count) as percentage of total employed (2007)	1.57	1.63	1.73
Researchers FTE (Full time equivalent) by sector of performance as a percentage of total			
Business enterprise sector	46	35	36
Government sector	13	17	3
Higher education sector	40	47	59
Profit and Non-Profit sector	1	1	2
+ The base year for above figures is 2008, unless specified			

29 and 28 percent negative difference, respectively, even though the country progresses with the similar AAGR (Table 1).

The next indicator to look into is R&D intensity as percentage of GDP by sector (Table 1). In the EU-27, 55% of R&D outlay was funded by the business enterprise sector and 34% by government. Although, business enterprise sector funding still lacks the Lisbon strategy target which is two-third of total outlay, at national level UK exceeds 2 percentage points when compared with Spain. In addition to that, the other positive that is performed by the UK pertains to its share of PNP (Profit and Non-Profit) sector funding. PNP sector funding signifies the potential for the output indicators. Similarly, the significant difference between the UK and other two entities (Spain and EU27) in terms of higher education sector expenditure as percentage of R&D. UK doubles that in comparison with EU27 and 50% more than Spain (Fig. 2). This, again, could potentially influence the numerous output indicators such as HRST (Human Resource for Science and Technology), employment in high technology sector, etc.

Finally, in 2007, R&D personnel comprised 1.57% of total employment in the EU-27 (in head count - HC) (Table 1). There is, however, a national variation. The UK has 10 and 6% increment in R&D personnel when, respectively, compared with EU27 and Spain (Fig. 3). Moreover, Spain comprised 3% more R&D personnel than EU27 average. Similarly, when compared the researchers (FTE) by sector of performance, consistent difference were observed. The breakdown of researchers by institutional sector reveals a complex picture across the EU-27. For instance, by performance: EU27, Spain and the UK have clear edge

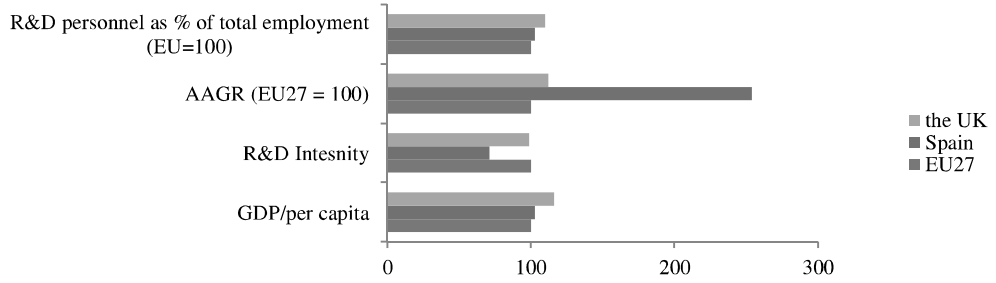

FIG. 1. INPUT INDICATORS

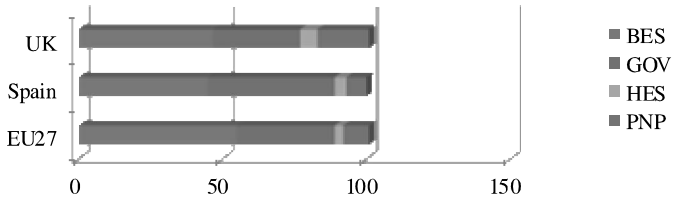

FIG. 2. R&D EXPENDITURE BY SOURCE OF FUNDS AS A PERCENTAGE OF TOTAL

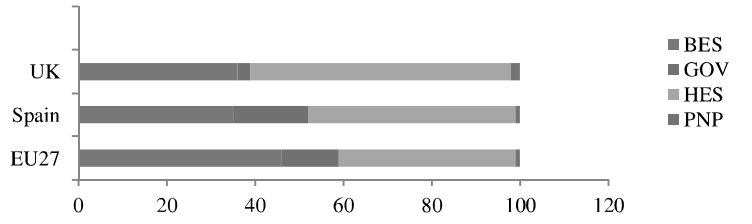

FIG. 3. R&D PERSONNEL (HC) AS PERCENTAGE OF TOTAL EMPLOYED (2007)

in Business enterprise sector; Government sector; and Higher education sector, respectively (Table 1).The national pattern also varies. In both Spain and the UK, the higher education sector accounted for the highest share.

4.2 Spain and the UK: The Output Indicators

The output indicators, as supplied in Table 2, selected in consonance with the literature reviewed earlier. First indicator analyzed for this study is patent applications. There is a significant difference between EU27 and selected countries. EU27 has more concentration of patent applications (117) against the UK (89) and Spain (33) (Table 2). Within national comparison, the UK has denser populations than Spain: the UK file nearly three times than what is done in Spain, in year 2008 (Fig. 4). The business enterprise sector as a share of total applications is almost similar for the UK and EU27; however, it shows significant decrease for Spain. ICT, an important sector for economy and job growth is chosen as an example to compare the national performance in terms of patent applications (Table 2). The UK has an apparent advantage again Spain and even EU27.

TABLE 2. NATIONAL OUTPUT INDICATORS+

Output Indicators	EU27	Spain	UK
Patent applications EPO (European Patent Office) per million population	117	33	89
Patent applications submitted by business enterprise sector as percentage of total applications	87.2	74.1	85
ICT patent applications to EPO as percentage of total	25.4	15.8	31.9
Percentage of employment in high technology sector			
Manufacturing	1.1	0.5	1.0
AGR(Annual Growth Rate) (2005-2009)	-6.0	-38.0	-13.2
Knowledge intensive sector	2.6	3.0	3.1
AGR (2008-2009)	-0.1	13.8	-16.3
HRSTC age 25-64 by occupation (2009)			
Professionals	52.4	46.1	45.2
Technicians and Associate Professionals	52.4	46.1	45.2
World market share for high technology sector (%)		0.5	3.2
High technology as percentage of total			
Percentage of total imports	11.9	10	15.1
Percentage of total exports	12.0	4.2	3.2
+ The base year for above figures is 2008, unless specified			

Finally, the world market share as a national output indicator is considered. There is enormous difference between Spain and the UK. Spain contributes ½ percentage of total world market for high technology, whereas; the same is more than six-fold for the UK (Table 2). Within the national boundaries, the share of

The performance indicator is generation of employment in high technology sector. EU27 and the UK are almost at same footing, as far as percentage of employment in high tech sector is concerned (Table 2). Spain, however, employs at least 50% less high tech sector. In addition to that, Spain has lower level of employment in high tech sector, the country has alarmingly negative AGR (-38.0) in high tech employment. Another interesting aspect of this indicator is that there is negative growth rate for all the selected entities (EU27 and the UK, as well). There is, however, a different scenario when it comes to look into knowledge intensive sector. There is not much significant difference amongst all the entities, but in absolute terms the UK have more percentage of employment in high tech knowledge intensive sector (Fig. 5). More interestingly, Spain is the only entity which shows significantly positive AGR; whereas the UK this time shows a significantly negative AGR (Table 2). One explanation for this is that service sector (which is typically knowledge intensive by nature) is gaining more importance than manufacturing sector. There is, however, a major concern for the UK to rethink their strategies to regain the share of employment, especially in knowledge intensive sector.

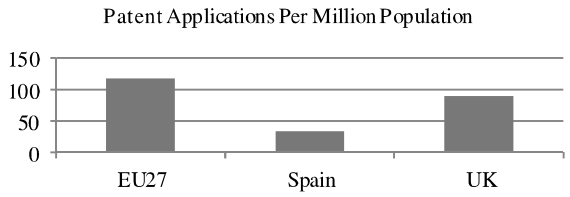

FIG. 4. PATENT APPLICATIONS (EPO) PER MILLION POPULATION

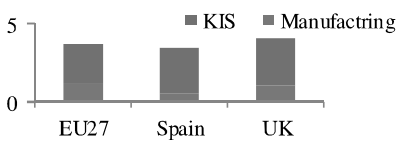

FIG. 5. PERCENTAGE OF EMPLOYMENT IN HIGH TECHNOLOGY SECTOR

high technology, both as percentage of imports and exports, exhibits a different scenario. The UK depends more on imports, within the selected entities. In 2008, the total percentage of imports in the UK observed to be 15.1, while same for Spain is 10; which is less than the total EU27 average is (Table 2). On the contrary the figures are reversed for the total percentage of exports: the UK exports about 3% of high technology goods and services, Spain exports about 4 percent and the same for EU27 is 12%.

These figures show that although the share of high technology exports in the UK is on a very high altitude, nevertheless, for a competitive advantage, it needs to focus more on increasing the export bills and decreasing the import bills. Spain, who due to historical reasons has less advantage in their share of global high technology share, on the other hand; should give emphasis on more innovative culture to be more export orient country. In brief, from Table 2 it is evident that in terms of performance and competitiveness the UK is close to EU27, but when it is compared with Spain there is a substantial gap between them.

4.3 Catalonia and N Ireland: Input Indicators

Unlike in the previous national comparison, where Spain was less populated than the UK, in this case the Spanish region (Catalonia) is more densely populated than the UK region of N Ireland. This is due mainly to the fact that Catalonia is a highly industrialized economy in Spain, where the quality of life and job opportunities are better than in the bulk of the Spanish regions, while it is not in the case of N Ireland for the UK.

In terms of absolute GDP per inhabitant, there is a significant difference between Catalonia and N Ireland. The GDP per inhabitant for Catalonia is 30,500 as against 23,100 for N Ireland (Table 3). Similarly, GDP per inhabitant in PPS Catalonia is 23 percentage points more than EU27 and N Ireland is nearly 7 percentage points less than EU27 (Fig. 6). The efforts for growth in GDP per inhabitant have been more positive as observed in the case of Catalonia. Since 2000, the overall increase in GDP per inhabitant in PPS for Catalonia and N Ireland is respectively +4.64 and -1.89, for the year 2007 (Table 3). The gross expenditure as percentage of GDP (GERD) is appearing to show the same trend, as previous indicator (Fig. 6). N Ireland spends 1.09% of total GDP on R&D; whereas, Catalonia spends 35% more share of its GDP in R&D in comparison with N Ireland (Table 3). Finally, the share of total employment for researchers is more or less similar figures for both Catalonia and N Ireland, i.e. 1.08 and 1.08 respectively (Table 3).

4.4 Catalonia and N Ireland: Output Indicators

Although there was significant difference observed in case GDP per inhabitant in previous section, there is no consistent difference appeared when it comes to employment rate. Catalonia and N Ireland have more than two-thirds of employed population. Similarly, high technology patents per million population is similar for Catalonia and N Ireland (Table 4). In 2005, it was found that better share of population (aged 20-24) in Catalonia is registered in tertiary education, i.e. student ration in tertiary education is 50.81 in N Ireland against 56.6 for Catalonia (Fig. 7). This shows that the potential for future human resource within the region.

TABLE 3. REGIONAL INPUT INDICATORS*

Input Indicators	EU 27	Catalonia	N Ireland
GDP per inhabitant (( )		30, 700	23,100
GDP per inhabitant in PPS (EU27=100)	100	123.25	92.76
Change of GDP per inhabitant in PPS as compared with the year 2000		+4.64	-1.89
R&D intensity (R&D expenditure as percentage of GDP)	1.90	1.47	1.09
Researchers as percentage of total employed		1.08	1.06
*The base year for above figures is 2007, unless specified			

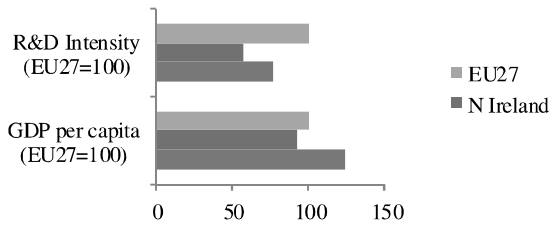

FIG. 6. INPUT INDICATORS

5. DISCUSSIONS

Consistent differences were observed within national and regional indicators, i.e. in terms of amount of an effort put into (inputs) and the relative performance achieved (outputs). For instance, EU27 allocate share of their R&D as a percentage of GDP more than either Spain or the UK (Table 1 and Fig. 1). The relative R&D personnel as a percentage of total employment for EU is 1.57 in comparison with either 1.63 (Spain) and 1.73 (the UK). In contrast, relative consistency is observed for R&D expenditure by source of funds and researchers (FTE) by sector of performance. EU27, the UK and Spain, respectively, spend 55, 45 and 47% of R&D funds on business enterprise sector and the relative researchers by sector of performance are 46, 35 and 36%.

For national output figures, EU27, Spain and the UK, respectively, filed 117, 33 and 89 patent applications per million population. Their respective applications submitted by enterprise sector as percentage of total applications is 87.2, 74.1 and 85.5 (Table 2). Moreover, world market share for high technology sector, also, have positive influence, i.e. 0.5% by Spain against 3.2% by the UK.

While comparing input figures with output figures from the tables, the similar tendency is observed, as above. For instance, relative R&D intensity as percentage of GDP by EU27, Spain and the UK is 1.90, 1.35 and 1.88 (Table 1), respectively. The relative patent applications filed per million population are 117, 33 and 89 respectively (Table 4). This shows the positive influence of R&D expenditure (input) over a number of patent applications (EPO) per million population. It, however, shows a different picture when it comes to comparing with high technology patent applications such as in ICT sector. EU27, who spent highest amount of R&D in a particular year record lesser percentage of ICT patent applications when compared with the UK (Table 4).

Within **regional context**, there is a lower level of inconsistency than what is observed within national context. Within the regional input figures, R&D intensity by Catalonia is far higher than N Ireland (Table 3 and Fig. 6); it, however, does not show the relative altitude within total number of researchers as percentage of total employment (Table 3). Contrary to the above, for R&D intensity and relative number of patent applications in high technology it shows consistent figures. Catalonia and N Ireland respectively spent 1.09 and 1.08% of GDP amount on R&D and their relative patent applications submitted by business sector show relative consistency, i.e., 87.2 and 85% (Table 3).

The Lisbon strategy for achieving a target of inputting R&D intensity as 3% of total GDP, does not seem realistically achievable in near future. Moreover, it is also beyond the scope of this research. However, as apparent from the figures and data, it could be relatively less challenging for the UK to make significant progress in the future. On the contrary Spain needs to make strenuous efforts to come close to the UK. Similarly, for EU27 this target is becoming more difficult with the advent of new members. It is important to understand that, when this target of R&D intensity was set for the EU, the number of member countries were 15, and large proportion of countries were developed economies with already strong intensity. Consequently, the new member states (12) included in EU27, were less strong economies.

Unlike the national comparison, the regional comparison largely exhibits a reverse mode in figures. Whereas, the R&D intensity of the UK is significantly

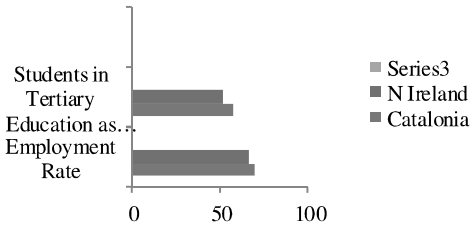

FIG. 7. OUTPUT INDICATORS

TABLE 4. REGIONAL OUTPUT INDICATORS*

Output Indicators	EU 27	Catalonia	N Ireland
Employment rate (%)		69.9	66.4
High technology patent applications to the EPO per million inhabitants (2005)		4	4
Students in tertiary education as percentage of population aged 20-24 (2005)		56.6	50.81
*The base year for above figures is 2007, unless specified			

higher than Spain, the R&D intensity for Catalonia is 35% higher than what is observed in the case of N Ireland. It does not essentially reflect in the consistency of researchers as percentage of total employed (Table 3). One reason as mentioned above could be that the UK has first mover advantage in registering itself as a knowledge intensive economy. The UK have well developed established base to undertake R&D activities and well developed institutions to ensure that. The earlier enforcement of National System of Innovation has beneficial effects on peripheral (weak) regions like N Ireland. Not only within input efforts, but a positive influence of input efforts over outcome (output) does not reflect in the figures. With relatively healthy R&D intensity, the relative high technology patents per million population and the employment rate for respective regions are largely similar (Tables 3-4). There is, however, one positive of Catalonia that could be inferred from figures is a share of students in tertiary education aged (20-24), in comparison with N Ireland.

From the above figures one can deduce that knowledge density and intensity are among the prime causes of innovative performance gaps. The significant differences between these two nations are also the result of the policies carried out in the knowledge production sector to exploit the skills and then applying them in the industrial or business sector for a better performance.

6. LIMITATIONS FUTURE DIRECTIONS

Firstly, the UK economy is very much dependent on the London region, and as much as 30% share of the whole country workforce comes out of this region alone. Similarly, Barcelona is the backbone of the Catalonian economy and has a major impact on the performance of the region as a whole. Concentration of universities within the city makes it a quite knowledge intensive city and it also has few of the best universities in Spain. It, nevertheless, does not have a significant influence on the outcome of the region as whole, as evident from the above discussion. It is hence inferred that strong NSI has a positive influence on RSI. It, however, could not be concluded from this limited research about the positive influence of NSI over RSI.

Secondly, a brief argument about the achievement of Lisbon strategy goals is given within discussion section. It, however, has not put into main discussion due to research limitations. It nevertheless constitutes an important topic for future discussions to assess the importance for both NSIs and RSIs. It is suggested new targets, in consonance with Lisbon strategy, are set as EU level and the role of NSI and RSI may be put into limelight in achieving those.

Thirdly, the influx of new member states is increasing and more European countries are striving hard to join this club. It appears to be of great significance to study the influence of new states on the outcomes of targets which were set for the original member states. That is, whether new states have positive or negative influence on achieving those. Apparently, it seem that new member states are less developed economies in comparison with original member states, with low level of S&T (Science & Technology) capabilities and competitiveness.

Finally, similar study could be undertaken in Pakistan, taking each province as a region. The study may highlight the disparity between four regions that could be a platform for provincial governments to pursue policies related to science and education policy leading to innovation.

7. CONCLUSIONS

The main outcome of the NSI is to create a National Capacity for Innovation, which is able to influence the performance of the countries in terms of growth, employment and competitiveness. S&T policies are critical elements for the development of modern societies, as it has now been clearly stated that there is a direct relationship between the innovation capacity of a country and its competitiveness.

The UK, having a 'first mover' advantage as an industrialized country, shows the strongest propensity towards innovation activity as against Spain, which is a relatively 'adolescent' NSI. Being one of the super powers of the past, the UK has a distinction in producing and housing human capital engaged in knowledge intensive tasks, which ultimately contributed to the high level of innovative activities. These are few of the facts apart from those already mentioned that rank the UK as one of the strongest EU nations engaged in innovative activities. All the above are lacked by Spain and make it a relatively less developed NSI.

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REFERENCES

[1] Niosi, J., "Regional System of Innovation: Market Pull and Government Push", Canadian Research Network on Regional Innovation System, Montreal, May, 2000.

[2] Freeman, C., "Technology Policy and Economic Performance", Published by Printer, London, 1987.

[3] Cooke, P.,"Regional Innovation Systems: Competitive Regulation in the New Europe", Geoforum, Volume 23, pp. 365-382, 1992.

[4] Rashdi, P.I.S., Abro, Q.M.M., and Bhutto, A.,"The Role of Academic Entrepreneur's Experience in Building Networks", International Journal of Business Innovation and Research, Volume 5, pp. 212-228, 2011.

[5] Rashdi, P.R.S., and Rashdi, P.I.S "Influence of Academic Entrepreneur's Human Capital on Developing Social Capital", The Triple Helix IX International Conference, Stanford University, California, USA, 11-14 July, 2011.

[6] Evangelista, R., Iammarino, S., Mastrostefano, V., and Silvani, A., "Looking for Regional System of Innovation: Evidence from Italian Innovation Survey", Regional Studies, Volume 36, No. 2, pp. 173-186, 2002.

[7] Corvers, F., "Indicators for Regional Innovation Performance –The Case of Italian Regions, Conference on "Regions and Innovation –Regional Policies for Territorial and Industrial Competitiveness", Florence, 12-13 December, 2003.

[8] Lundvall, B.A, "National Innovation of innovation: Towards Theory on Innovation and Interactive Learning", Anthem Press, London and New York, 2010.

[9] Nelson, R.R., and Rosenberg, N., "Technical Innovation and National Systems", National Innovation Systems: AComparative Analysis, Nelson, R.R. (Editor), Oxford University Press, London, 1993.

[10] Cooke, P., and Morgan, K., "The Associational Economy: Firms, Regions, and Innovation", Oxford University Press, New York, 1998.

[11] de la Mothe, J., and Paquet, G., "National Innovation Systems and Instituted Processes", Regional Innovation and Global Change, Acs, Z.J. (Editors), London, 2000.

[12] Lundvall, B.A.,"Innovation, Growth and Social Cohesion: The Danish Model", Cheltenham, Edward Elgar, 2002.

[13] Howells, J., "Regional Systems of Innovation", Innovation Policy in Global Economy, Archibugi, D., Howells, J., and Michie, J., (Editors), Cambridge University Press, 1999.

[14] Mosey, S., Lockett, A., and Westhead, P., "Creating Network Bridges for University Technology Transfer; The Medici Fellowship Scheme", Technology Analysis and Strategic Management, Volume 18, No. 1, pp. 71-91, 2006.

[15] Cantwell, J., and Iammarino, S., "Regional Systems of Innovation in Europe and the Globalization of Technology", Multinational Corporation and European Regional systems of Innovation, Chapter-2, London and New York, Routledge, 2003.

[16] Morgan, K., "The English Question: Regional Perspectives on a Fractured Nation", Regional Studies, Volume 36, No. 7, pp. 797-810, 2002.

[17] Yin, R.K., "Case Study Research: Design and Methods", Newbury Park, CA: Sage Publications, 1984.

[18] European Union "Europe in Figures — Eurostat Yearbook 2010", Eurostat, Printed in Belgium. 2010.