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University–Industry Relationships in Developing Countries: Opportunities and Challenges in Algeria, Indonesia, Malaysia and India

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Abstract

This article is aimed at investigating the various opportunities as well as the challenges faced by National Systems of Higher Education in aligning themselves with the requirement of National and Regional Innovation Systems in developing countries. It achieves this by comparing various practices of university–industry relationship across four different countries, investigating the links of these universities with regional and/or national systems of innovation and their position within the three-stage evolutionary process (statist, laissez-faire and hybrid) of the Triple Helix system. The article argues that a healthy balance of diverse types of higher education institutions (HEIs) across regional and national levels in a country might be necessary for better national innovation performance.

1. Introduction

The main objective of this article is to gain a better understanding of the different opportunities that have opened up for universities[1] in developing countries as well as the challenges facing them if they are to be expected to play more active roles in their national and/or regional system of innovation. For this purpose, the article compares the different opportunities presenting before and the challenges faced by universities in selected countries (India, Malaysia, Indonesia and Algeria) in linking themselves with their surrounding industrial environment. This article argues that the challenges faced by

and the opportunities presenting to universities in developing countries to link with their industrial partners would be contingent upon the peculiar characteristics of the country's National System of Innovation and its National System of Higher Education. This would make the implementation of university– industry linkage programmes such as Triple-Helix (TH) by policymakers in developing countries less straightforward.

In addition to the introduction, this article comprises seven sections. Section two analyses and discusses different possible scenarios of the National Innovation System (NIS) that may exist in developing countries. It will base its analysis on the type of key institutional members (or stake-holders) of the National Innovation System. Section three focuses on the regional innovation system and the concept of proximity. Section four proposes an analytical framework consisting of different combinations of the national and regional systems of innovation that would create different challenges and opportunities to the university–industry linkages developing countries. Section five explains our research methodology, which is essentially qualitative and based on a multiple case studies approach, which includes India, Malaysia, Indonesia and Algeria. Section six presents our four case studies, while section seven provides a comparative analysis and discussion of the practices of university–industry relationships in developing countries. The final section concludes and discusses the policy implications of our findings.

2.   Different scenarios of national innovation systems in developing countries.

The concept of innovation systems can be understood as a network of actors/institutions that interact in the production, transfer, diffusion and use of new knowledge or technology to produce innovation. According to Edquist (2005), this system consists mainly of the following sub-systems: production sub-systems that consist of all institutions that are able to transform economically useful knowledge into economically competitive goods and services; research sub-systems that consist of all institutions that can create and produce economically useful knowledge; financial sub-systems that consist of all institutions that are accessible, receptive and able to support these innovative endeavours; and training and education sub-systems that consist of all institutions that are able to produce not only highly skilled and educated labour but also creative, innovative and entrepreneurial human resources to feed into the NIS. Across these subsystems, depending on the peculiar social, economic and political characteristics of a particular country, the following institutions may play a vital role: firms, government institutions, higher education institutions (HEIs), financial institutions and society. The combinations of this actor–system characteristic of NIS can be schematized in the matrix below. In many developing countries, the ownership of some of the NIS institutional actors can vary from public sector, to private sector, to even 'third sector' (such as NGOs, non-profit organizations, social entrepreneurs, society, etc.). NIS

with the majority of its main institutions owned by the government can be considered state-controlled NIS. On the other hand, NIS with the majority of its main institutions owned by the private sector can be considered privately controlled NIS. Finally, NIS with the majority of its main institutions owned by the 'third sector' can be considered socially controlled NIS. In developing countries, only pure state-controlled NIS have existed, with firms, HEIs and financial institutions all owned by the state. In reality, in many developing countries, the NIS are usually controlled partly by the state, private and third sectors.

Further, even though its performance lies on the effective running of all institutional actors as well as on the effective linkages and relationships between actors, without a doubt the direction of innovation within a NIS is largely determined by the mechanism that exists within its production sub-system (Edquist 2005). In some developing countries, this system is heavily (if not all) populated by state-owned institutions. Such NIS can be considered 'driven by state'. If the production sub-system is populated mainly by institutions from the private sector, then one can consider such a system to be driven by 'market'. Finally, if the production system is full of institutions owned by the 'third sector', it can be considered as socially driven NIS. The combinations between the control-driven dimensions above create varieties of NIS in developing countries.

3. Different innovation system arenas: analysis based on proximity concepts

In addition to the interactions between key players, it is also important to take into consideration and investigate the arena within which these players engage in the process and system of innovation. As the 'system of innovation' concept deals mainly with the effective flow of knowledge between key players to
produce innovation, the different innovation system arenas in which these actors mainly get involved can be understood according to the concept of proximity. According to Oerlemans et al. (2001), the concept of proximity assumes that a greater level of networking is seen as a means of facilitating learning, transfer of technology and innovation. Proximity can lead to the development of trust and mutual understanding, which can help establish strong relationships (Doloreux and Parto 2004) that are crucial for effective innovation systems.

This section shows that in the context of spatial analysis there are mainly two competing proximity concepts in Innovation System studies: the national and the regional system of innovation. Universities are supposed to be involved in either the national or the regional system of innovation.

Initially, the concept of innovation system was used at a national level by Freeman to explain the (uneven) innovation performance of nations (Freeman 1987, 1995; Lundvall 1992; Nelson 1993). The authors argue that the innovativeness of a nation depends on the close relationship and proximity between key institutions that operate at the national level to support and produce innovation. One of the corollaries of this concept is that

industry is expected to play a significant role in the innovation system at the national level.

However, certain scholars started to question the adequacy of using a nation as a unit of analysis for studying innovation performance. Furthermore, some empirical evidence shows that the ability to innovate is believed to be more likely to be dependent on local than on distant linkages (Audretsche 1998; van Dijk and Sandee 2002). Indeed, substantial empirical studies show the existence of a geographically bound spill over of knowledge and graduates from university to industrial innovation (Mansfield 1995). It is also worth noting that a high level of proximity can be counterproductive and adverse to learning and innovation (Oerlemans et al. 2001). Strong ties can, for instance, generate the risk of lock-in in specific relations, high dependency, lack of flexibility and barriers to novelty and initiatives.

To take into account this geographical dimension, Cooke and others (Cooke 2001; Cooke et al. 1997) proposed the concept of Regional System of Innovation. The corollary to this proposition is that universities are expected to play a significant role in the innovation system at a regional level. This argument is supported by some previous theories in innovation studies, notably the Innovative Milieu study (Longhi 1999).

4. Various positions of universities in the system of innovation: a theoretical framework

This article proposes that the opportunities presenting before and the challenges faced by any university in supporting the system of innovation of a particular nation would be contingent upon two factors. First, there would be different roles, opportunities and challenges for HEIs, whether they are positioned within the Statist, laissez-faire or Hybrid regime. Second, there would be different roles, opportunities and challenges between HEIs that operate within certain regional/local boundaries or mainly interact with regional/local partners or else serve the interest of regional/local needs, and the institutions that operate, interact or serve nationally – in line with the idea of proximity explained beforehand.

4.1. The position of universities between different types of Triple Helix interactions

As already explained, the TH concept argues for the importance of a hybrid model of organization between university, government and industry to produce innovation (Etzkowitz and Leydersdorf 2000). Since its conception, it has been used and adopted by many scholars to analyse the rise in industrial innovation in particular sectors/technologies in both developed and developing nations (e.g. Giesecke 2000).

Unlike the 'classic' innovation system concept (e.g. Freeman 1995; Nelson 1993; Rosenberg and Nelson 1994) that implicitly suggests the 'disciplined' division of labour

among its constituents, the TH concept suggests not only a more collaborative but also an aggressive approach to its constituent institutions by actively playing the role of the others. For instance, if the industries are not able to absorb their breakthrough knowledge production, universities should try to pursue their exploitation in order to develop innovation and thus be more entrepreneurial (Etzkowitz 2003). In addition to playing a crucial role in the production of knowledge (Philpott et al. 2011), universities are increasingly expected to take on the role of an 'exploiter' of knowledge (to produce innovation).

In the Statist regime, HEIs are expected to carry out their social contracts under the supervision of the government/authorities. They act as 'subordinates' and 'executors' of government (e.g. innovation) programmes. We can expect many universities from developing nations to fall into this category. The challenge for universities in this regime is to be able to bargain with the authority to obtain a certain degree of freedom for managing their own resources to build necessary capability in order to react rapidly to social and economic change in the society.

On the contrary, in the 'laissez-faire' regime, all institutions are autonomous and independent of each other. Their interactions are more likely contractual or transactional across institutional boundaries (Williamson 1973) as actors are expected to act competitively rather than cooperatively. According to Etzkowitz (2003), universities usually operate in accordance with their scholarly role in society. Taking it too far, the HEIs in this regime may develop into an elitist academic institution (Ivory Tower Universities) that pursues teaching and research according to its own academic agenda. Within this regime, universities act as an 'explorer' of new knowledge and opportunities.

The types of challenges that universities face will depend upon the regime within which they are positioned. In the Statist regime, universities are unlikely to have sufficient 'ready-on time-to-use' capabilities as well as incentives to lead their own innovative activities unless they are initiated or planned by the government. The capability-building and innovative research for innovation is likely to be conducted in a more reactive way in accordance with government initiatives. It is expected that the reaction time of the higher education system to match with industrial and societal needs of the nation will be limited as the ability of the government to foresee the changes of needs in society, industry and economy is somewhat limited.

Nevertheless, despite these problems, universities in this regime would enjoy relative safety from the risks associated with capital loss due to innovation or experimental failure. It may also enjoy preferential treatment for undertaking specific innovation projects that are deemed by the authorities to be important and necessary without worrying about their cost. Thus, the opportunity for the Statist universities to become involved in the innovation system usually comes from government innovation procurement projects. The challenge for universities in this regime is to be able to bargain with the authority to obtain a certain degree of freedom for managing their own

resources to build necessary capability in order to react rapidly to social and economic change in the society.

Meanwhile, universities that operate under the 'laissez-faire' regime would enjoy a certain independence to develop their own capabilities and research agendas. However, this capability building and research development are not necessarily oriented towards societal or economical needs. In many universities within the 'laissez-faire' regime, these developments are mainly scholarly driven. The match between university research agenda or capability building with certain societal or industrial short-term needs is at best unplanned or at worst accidental. Even though universities have the capability to explore new knowledge, they lack the urgency to develop their capability to exploit the new knowledge and turn it into innovation. The gain that this regime enjoys from the relatively lower cost of structural adjustment for innovation (partly due to lower interventions of each other institution) can be offset by the inefficiency of the interactions (partly due to the hit-and-miss phenomenon of matching university research with societal and economical needs).

As the opportunity to participate in an innovation system will come from the match between university resources and capabilities with certain societal and industrial short-term needs, and given the independence of relationships between universities and other innovation key actors, universities need to always develop their resource capabilities by themselves (Saad et al. 2014) in order to be able to contribute to the innovation system, which in turn would be very costly to run (Philpott et al. 2011).

One of the challenges faced by universities in this regime is ensuring sustainable financial plans for growth. This can be done partly by planning and managing the direction of its resources and capabilities development so that they are always relevant to societal and industrial needs (not merely pursuing scholarly needs). Many scholars such as Etzkowitz and Leydesdorff (2000), Kitagawa (2005) and Shattock (2005) contend that having to respond to societal and industrial requirements represents an opportunity to universities.

Finally, in the hybrid model, universities are expected to always have at least sufficient[2] capability not only to search for new knowledge but also to exploit it and innovate. By having these multiple sources of innovation (i.e. from the universities instead of merely from industry), innovation performance of a region or a nation can be accelerated. However, this hybrid model of universities should be expected to require a higher amount of organizational flexibility as well as managerial/ entrepreneurial capability to respond to the changing needs of society and industrial economy. The challenge of the university in this model is to be able to manage its structural adjustment inexpensively while responding to ever-changing needs of society and industry. The ability of universities to engage effectively in the hybrid model is contingent upon the context and resource based capability and capacity (Philpott et al. 2011).

4.2 The position of universities within different levels of innovation systems

In this theoretical framework, the difference between the National and the Regional System of Innovation from the point of view of HEIs is associated with the scope of university activities. Some universities in certain countries – due to their particular resources or characters – may limit their teaching and research activities as well as their economic uses to serve mainly regional or local needs. They may be private or public but they operate within regional boundaries and interact mainly with local partners and fill specific needs (both in providing skilled graduates and specific problem-solving knowledge) to the particular region. They play a more focused role by serving niche social and economic needs.

Other universities operate at the national level. Their scope of teaching and research activities (deliberately or not) is so wide and diverse that they can serve the needs of various innovative regions within particular countries. When institutions are specialized in particular subjects or activities, their inter-action with other types of innovating institutions happen mainly at a national level rather than at the regional level. Again, these universities can be public or private HEIs, serving a variety of different societal needs and/or dealing with a variety of partners and stakeholders.

The universities that operate in different spectrums of the innovation system face different challenges and opportunities in their teaching and research activities. The more situated universities are at the national level of the innovation system, the more the number of stakeholders they have to deal with. They can also be likely to have to deal with more competition for resources while at the same time having to operate at larger operating costs since they have to provide a wider scope of teaching and research activities. Nevertheless, they might enjoy a greater institutional reputation, which can be beneficial for their funding.

4.3 The conceptual framework

These different challenges and opportunities along the two dimensions explained above will certainly create different paths of development if the government or policy-makers want to develop higher education systems that support their national/regional innovation system. Figure 1 summarizes this framework.

MAIN ARENA FOR
INNOVATION SYSTEM
INVOLVEMENT

National
(Wider role)

Opportunities incl.:
- Access to higher number of funding opportunities,
- Increase of reputation.
- Working for diverse needs.

Challenges incl.:
- Dealing with increasing number of stakeholders,
- Dealing with more sophisticated stakeholders,
- Dealing with more competition for resources.
- Working efficiently with higher operating costs.

Local
(Focus role)

Opportunities incl.:
- Working closer with local partners,
- Increase the applicability of innovation to serve local needs,
- Working on niche needs.

Challenges incl.:
- Dealing with limited number of alternatives/options of actions.

Statist	Laissez Faire	Hybrid
(Executor role)	*(Explorator role)*	*(Exploitator role)*
Opportunities incl.:	Opportunities incl.:	Opportunities incl.:
• Preferential partnership on Government innovation Procurement programs,	• Freedom to manoeuvre,	• Freedom to manoeuvre,
• Opportunity to participate in big, complex, government innovation procurement projects.	• Able to freely develop wider palette of diverse capabilities of which some of them can be useful to society & industry.	• Being more able not only to produce new knowledge but also to exploit them quickly into innovation opportunities.
• Higher absorption of innovation failure due to government backing	Challenges incl.:	Challenges incl.:
Challenges incl.:	• How to avoid becoming trapped into academic ivory tower institution,	• How to effectively manage and absorb high risk of innovation failure,
• How to overcome slower reaction time to capability building to respond to rapid changes in society & industry	• How to effectively matching internal capabilities with external needs,	• How to effectively foresee the change of societal and industrial needs in order to develop effective institutional development strategy,
• No freedom to manoeuvre.	• How to developed diversified funding sources to compensate the running inst. at highly operating cost.	• How to manage organisation flexibility.

TYPES OF INNOVATION KEY PLAYER INTERACTIONS
ACCORDING TO THE TRIPLE HELIX FRAMEWORK

Figure 1: Different roles and positions of HEIs in supporting the innovation system: Their challenges & opportunities.

It is obvious from the framework that it is possible to have different types of HEIs within a particular national system of innovation along the two dimensions. Somewhat surprisingly, the possibilities of such diversity and its impact on the innovation system have not been considered in conventional innovation system theories such as NIS and Triple Helix Thesis. These theories espouse a certain kind of university that is considered 'fit for purpose' and the general suggestion is that policy-makers should strive to make the conditions right within the innovation system so that this ideal type may thrive. But this raises the question whether such a homogeneous university system is actually desirable. It is widely acknowledged that diversity is a positive and necessary feature of HES (Trow 1995) that can help in responding more effectively to the varying needs of the many stakeholders of higher education (Conceição and Heitor 2005; Horta et al. 2008).

In line with the above views, we contend that a healthy balance of universities across different positions in our theoretical framework might be necessary to accommodate

different innovation needs, requirements and opportunities of a nation. In any nation, there are a variety of innovation needs, of which particular needs may be suitable to particular types of universities. We also argue that an unbalanced university population in a country would create problems with the innovation system because certain types of innovation needs and opportunities might be overlooked to be supported by its higher education sector. We suspect that this situation occurs frequently in developing countries. In order to illustrate our argument, in the following sections, we are going to map the state of university population diversity in various developing countries into our framework of analysis.

5 Research Methodology

This section briefly explains and justifies the research methodology that is essentially qualitative based on multiple case studies (Yin 1994). This approach is deemed appropriate for comparing the study of the dynamics of relationships that exist between universities, governments and industries within the four countries (Algeria, Indonesia, Malaysia and India). Data on the relationships between universities, industries and governments and the role of universities have been collected through in-depth interviews and desk research. The case studies, which are built from the collected data, provide an insight into government policies and their impact on relationships and the roles of universities. Through this exercise, we expect patterns to emerge in terms of similar as well as contrasting features across the cases. The above theoretical framework is expected to help us analyse the roles of universities in developing nations. Additionally, quantitative data from patent and publication databases are added to compare the relative performance of the country on knowledge production and innovation-related activities (e.g. Moed et al. 2004).

6 Various roles of universities in Algeria, Indonesia, Malaysia and India

The four cases to be discussed in this article are selected because of their relatively contrasting features. Algeria and Malaysia represent relatively small-sized countries in comparison to Indonesia and India in which the tension between the local and the national system of innovation might be more noticeable. Meanwhile, Malaysia and India can be regarded as the two countries with a more advanced and effective implementation of TH strategy for their higher education sector in comparison with Algeria and Indonesia.

The noticeable features of these roles from the four case studies can be highlighted in Table 1 below.

	Arena of innovation system regional vs national institutions	Evidence of autonomy	Evidence of institutional entrepreneurial activities
Algeria	Only public HEIs at the national level acting mainly as the 'executor' of the central government	Minimal	Still at its infancy (with some fairly recent evidence about the awareness within few specialized and new HEIs to act as the 'exploiter' of knowledge
Indonesia	For both state and public institutions (mixed roles of public HEIs as the executor of central/local government) Mainly local for private institutions	Partial for public institutions Maximal for private institutions (private HEIs are expected to act as the 'explorer' of local knowledge	No noticeable evidence

Malaysia	For both state and public institutions (mixed roles of public HEIs as the executor of central/local government)

Mainly national for private institutions | Partial for public local and national institutions

Greater autonomy for private institutions (private HEIs are expected to act as the 'explorer' of knowledge | Exist in some institutions (Some HEIs take the role

of the 'exploiter' of knowledge) |
| **India** | Both for public institution (mixed roles of public HEIs as the executor of central/ local government) | Minimal for the majority of public institutions

Significant for certain selected institutions (certain public HEIs are expected to act as the 'explorer' of knowledge)

Greater autonomy for private universities (certain HEIs are expected to act as the 'explorer' of knowledge | Exist in some institutions (some HEIs take the role of the 'exploiter' of knowledge) |

Table 1: Summary of the four country case studies.

7 Results and discussion: Mapping the position of universities in developing countries within the innovation system – triple helix framework

The result of the above case studies is quite straightforward. There are different patterns of university population diversities across the studied countries.

Algeria shows a certain concentration of universities towards the upper-left hand corner of our framework. All Algerian HEIs are still under the control or direct supervision of the Algerian government. Even though there might be some trace of autonomy granted to these institutions, in general their contribution to the innovation system would be the result of government intervention into their research and teaching agenda (Saad and Zawdie 2005). Some evidence of awareness about entrepreneurship and collaboration within the industry has started to emerge gradually (Menail 2013) with the recent set-up of Technology Transfer Offices (TTO) and links with the industry. In parallel to this, most (again, if not all) of these institutions operate at the national level. Even though their geographical positions might be spread all over Algeria, their role is essentially an extension of the central government arm to local regions (Saad et al. 2008). There is no strong evidence that these geographically spread HEIs serve local and regional innovation needs. The map of Algerian HEIs in our Innovation System – the Triple Helix framework – can be illustrated in Figure 2 below.

Meanwhile, the Indonesian case shows another interesting pattern. There is a mix between *Statist* type of HEIs, which are public, and the 'laissez-faire' type of institutions, which are mainly private (i.e. some public institutions have recently been granted wider autonomic rights). However, practically no HEIs have shown an entrepreneurial flair – for example, by establishing noticeable Science & Technology incubators or noticeable formal TTO. In addition, most of these HEIs operate at the local/regional level serving the local needs of skilled graduates as well as working with local partners. Only a small number of institutions have the capability to operate at the national level to contribute to the national system of innovation of the country. Among these HEIs, practically no private institutions with their 'laissez-faire' autonomic privilege have established the reputation at the national level to serve the needs of the Indonesian national system of innovation. Even though the Indonesian HEI
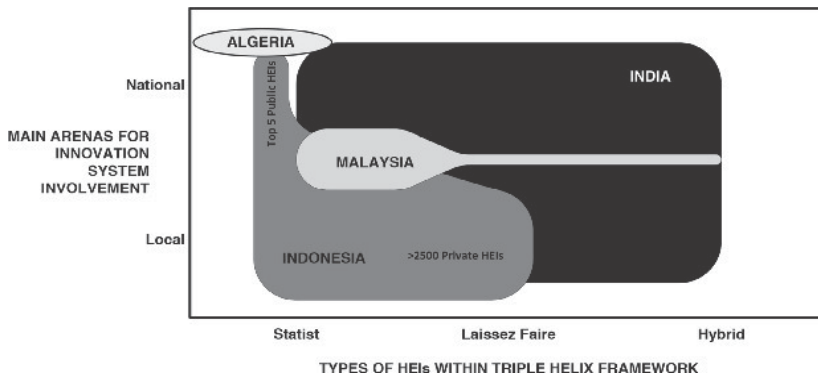
Figure 2: Map of Algerian, Indonesian, Malaysian and Indian HEIs within the System of Innovation – Triple Helix framework.

system is more diverse than the Algerian, at the national level they are more or less comparable in their capacity to contribute to their respective national system of innovation (see Figure 2).

Unlike Algeria, Malaysian HEIs are more diverse. In fact, for a relatively small country with a small number of institutions, Malaysia HEIs are more diverse in comparison to Indonesia according to our Innovation System – the Triple Helix framework. Even though the majority of its HEIs are either federal or regional state public-owned institutions, some of them enjoy a certain degree of autonomy to develop their own teaching and research agenda. One may trace early evidence of entrepreneurial flair as some of these institutions have started establishing TTO offices and are involved in patenting and technology licensing activities (see Figure 2).

The HEIs in India are more diverse than those in other countries. In India there are HEIs that operate both at the national and the regional (state) level. Although the traditional institutions are under the strict control of authorities, some institutions enjoy complete autonomy, such as IIT, IIS and other private universities. Certain private universities operate both at the regional and the national level.[3] Some of the institutions are involved in entrepreneurial activities, such as IIT and IIS (see Figure 2).

It can be seen easily from the map that the diversity of roles of HEIs in a country can be associated with its relative innovation performance (see Table 2 below for publication data as an indicator of knowledge production performance and Table 3 for patent data as an indicator of innovation performance). Even a slight trace of diversity as shown in the case of Malaysia can be associated with its relatively higher performance in innovation. Even though Indonesia has a relatively higher number of HEIs, their positions are rather concentrated within the local *Statist* and 'laissez-faire' region of the framework. Only a small number of public universities that are somewhat under the

Statist regime have the capability to operate at a national level. This explains the relatively lower performance of this big country in innovation in comparison to its peers such as Malaysia. Algeria can be clearly considered the least performing country where most of its institutions are situated within the smallest region on the map, while India is the better performer in comparison with the other three as it occupies most of the region in the framework.

	Total	University contribution (approximate value)	University contribution to total (approximate) (%)
Algeria	6281	4959	78.95
Malaysia	1385	12734	91.94
Indonesia	4113	2947	71.65
India	179727	133257	74.14
Vietnam	4249	3484	82.00
Thailand	21540	19519	90.62
China*	258643	251336	97.17
Japan	457374	412579	90.21

*In the case of China we only count the publications from 2005 to 2007 *Source:* ISI Science Citation Index

Table 2: ISI science citation indexed publications between 2005 and 2009.
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Assignee country	Patent database	Total patents	University patents	Government patents	Private patents*
Algeria	USPTO	0	0	0	0
	WIPO	45	1	0	44
Indonesia	USPTO	30**	0	0	30
	WIPO	110	0	1	109
Malaysia	USPTO	101	4	5	92
	WIPO	967	***	***	***
India	USPTO	n/a	n/a	n/a	n/a
	WIPO	7357	***	***	***

*Including individuals.

** The majority of these patents are design patents.

*** Several but not specifically counted. *Source:* USPTO

Table 3: USPTO & WIPO (PCT)-granted patents applied between 2005 and 2009.

8   Conclusions and some implications to policy-making

In conclusion, it is not a question of the sheer number of HEIs that a country should have but rather the diverse roles and types of HEIs that exist in a country – fulfilling the needs of various innovation opportunities and requirements – that, at the end, can determine the innovation performance of the country. A high number of HEIs can become worthless if they only serve the needs of a particular segment of society and industry. A healthy balance of different types of HEIs would provide the country with a wider palette of knowledge needed for effective innovation.

For policy-makers, the implication of this conclusion on the selected countries above is then pretty obvious. The countries that have a higher proportion of *Statist* HEIs controlled by the government and operating at the national level, like Algeria, should grant certain autonomy to some of their institutions while at the same time offering opportunities to some of their institutions to operate at the local level addressing their social and industrial needs and contributing to their local economic and social

development. A strong state control will only continue to exert coercive forces over its HEIs, which is likely to lead to structural and institutional isomorphism.

Meanwhile, countries with a higher proportion of their institutions operating at the local level should help some of them up their game and build sufficient internal capabilities in order to support innovation at the national level. They should also start supporting some of their institutions to become more entrepreneurial in order to better exploit the knowledge that these institutions have produced. Finally, the countries which already have a diverse type of institutions like Malaysia and India should enhance the diversity of their HEIs as suggested in Figure 3.
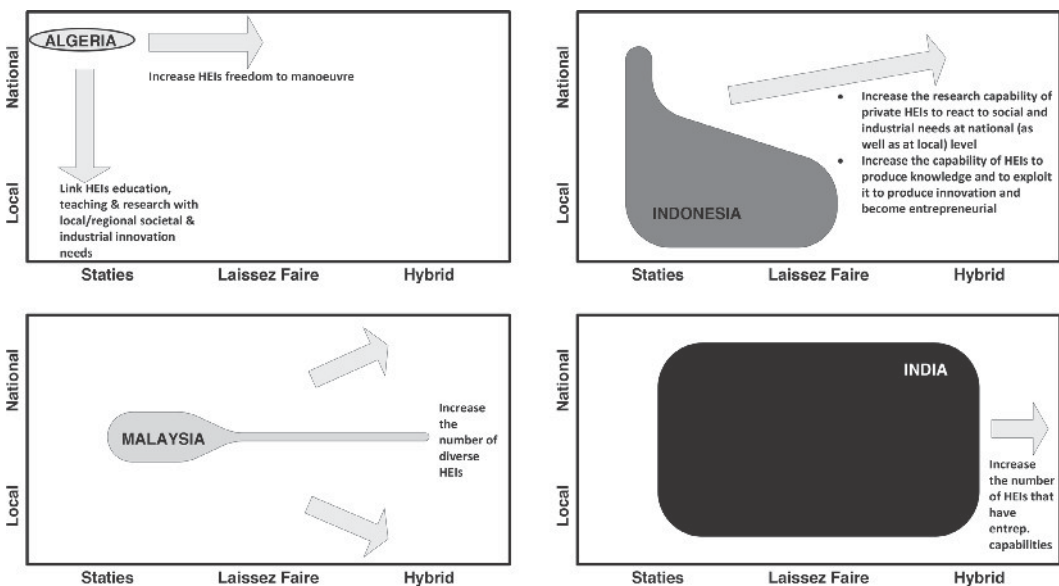

Figure 3: Options for Algerian, Indonesian, Malaysian and Indian policy-makers to increase the impact of their HEIs on innovation.

In general, governments should ensure diversity of their HEIs. It should grant them freedom to regulate their own affairs while protecting, supporting and helping the area in the framework where their involvement is seen to be lacking. In this system, each HEI is expected to adopt a differentiation type of strategy that is
contingent upon the conditions of its internal and external environment and will maximize its competitive advantage. This in turn will maximize the diversity of HEIs in the countries. This leads to the conclusion that there is no clear-cut recipe to foster diversity. There is also a need for a trade-off that helps combine and sustain the positive features of different approaches in order to better accommodate the complex and changing requirements of the different stakeholders.

This conclusion is somewhat different from that of the TH concept, which implicitly suggests that all universities in the end are expected to become entrepreneurial

universities. We argue that this type of suggestion can be counter-productive as in the long run such HE systems can run out of ideas for its exploitation activities and may need fresh knowledge produced by its more explorative institutions.[4]

In the future, a more quantitative approach will be used to assess whether the diversity of HEIs in a country can be associated with its innovation performance as well as the direction of causality between the two constructs. In order to do this exercise, exhaustive survey questionnaires have been designed to capture the diversity of HEIs in particular countries.

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