University and Innovation: The Case of India

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Abstract:

System theories of innovation such as the concepts of National Innovation System, Triple helix Thesis, and National Innovative Capacity underlie the importance of universities in enhancing and sustaining innovative capacity of regions and nations but at the same time, this role is conceptualised in distinctive fashions within these theories. These differences are noted and then evaluated in the context of India. The paper argues that the contribution of the university sector to India’s innovative capacity cannot be adequately explained through these frameworks as they do not address key dynamics that are in play. There is need for significant adaptations if these conceptual frameworks are to serve their purpose in understanding of the innovation dynamics in the country and guide policy making.

Introduction

The role of academia in the innovation system of India is a subject that remains largely unexplored and this paper seeks to redress this imbalance. The paper is structured in the following way. First, a conceptual discussion is undertaken to expand on the notion of system of innovation by analysing three theoretical frameworks that focuses on this issue. This discussion is encapsulated by mapping the differences and commonalities that exist within these theories in relation to the roles of the main institutional actors in a nation’s innovation system- the university, the industry, and the government. Second, the case of India is presented. The case study traces the evolution of the higher education sector in India from its pre-independence era to the present day and highlights how it is contributing to the innovative capacity of the country. The discussion also throws up some of the path dependent issues that have risen during the sector’s long history of over 150 years and which acts as obstacles to the sector in playing a more active role in the country’s innovation system. In the final section, the experience of India is evaluated against established concepts of innovation systems in reference to the role of university as theorised in them. Key differences are pointed out and suggestions are made on the kind of adaptations that would need to be made to make these theories more useful in the Indian context.

Innovation Systems and the Role of the University
It is now being increasingly recognised that innovation happens through a complex set of interactions and interrelationships between institutional actors such as government, industry and the academia. While remaining true to the Schumpeterian notion of innovation as a phenomenon which creates value through novel recombination of existing resources (Schumpeter 1934), these theories underplay the role of individual agents (the entrepreneur, for example) in the process and focuses on the set of institutions that govern the interactions between actors involved in the innovation process (innovation policy, for example), and institutional actors such as the firm (or industry), government and the university.

In the following section, three different conceptual frameworks- National System of Innovation, Triple Helix Model, and National Innovative Capacity-are discussed to bring out both the similarities and the differences between these theories in relation to the role of university as specified therein. Whilst all three agree that the university play a key role in the development of the innovative capacity of a nation, considerable differences of opinion exist in terms of what this role should involve. This conceptual discussion on the role of university in the innovation system of nations informs the analysis in later part of the paper where these ideas are applied and evaluated in the context of India.

**National System of Innovation**

The concept of National System of Innovation (hereafter, NSI) was popularised through the writings of Chris Freeman, B A Lundvall and Richard Nelson starting from early 1990s though its origins can be traced back as early as the nineteenth century to the German economist, Frederick List (Freeman 1995). Going against the scholarly orthodoxy of the time, which was based on the Smithian and Ricardian ideals of free trade unhindered by government intervention, List argued for a role of government in development of an industrial base which would, according to him, lead to economic prosperity. It is important to note here that there was disconnect between theory and practice at the time and which arguably persists till date. While classical theorists such as Adam Smith and David Ricardo advocated free trade and minimal government interference, in practice most countries, notably amongst them United States, practiced protectionism especially in the initial stages of their industrial development. List was particularly impressed by the efforts of Alexander Hamilton in development of an industrial base in United States (Shafaeddin 2000) and wanted his own country, Germany to emulate his policies. Without going too much into detail, it is sufficient to say, that List was amongst the few in early nineteenth century who advocated for an active role of the government in promoting certain kind of industries with the ultimate aim of generating a higher level of economic growth. Chris Freeman, the main proponent of NSI acknowledged the intellectual legacy of List when he wrote (2002: 12)

“List’s clear recognition of the interdependence of domestic and imported technology and of tangible investment has a decidedly modern ring. He saw too that industry should be linked to the formal institutions of science and of education”
This remark also bears the hallmark of the concept of NSI. Contra-distinct to the approach that gives primacy to individual entrepreneurs or firms as the key driver of innovation, NSI strikes a balanced perspective by highlighting the interrelationships and interdependence of the industry, government and academia in the innovation process. The network approach of NSI suggests that innovation occurs in a complex web of people, organisation and institutions. Further unpacking the structure of the network, Lundvall (1992) argues that the two most important dimension of it are the ‘structure of production’ and the ‘institutional set up’. It is the way that the two interact with each other that determines the productivity of the system. Rather than looking at firms as the sole engine for innovation, NSI recognises that organisations reside in a broader socio-economic context which they affect and in turn gets influenced by its political, social, cultural and economic factors.

Role of university in NSI

The network perspective of NSI suggests that the ability of the firm to innovate is dependent on a host of interlinked and interdependent factors such as the quality of the national education system, industrial relations, quality of technical and scientific organisations, government policies and cultural traditions (Freeman 1995). NSI prescribes a broad division of labour for agents involved in the innovation process. It’s the role of firms to convert ideas and inventions to innovation that is to commercialise them. Government plays a supporting role by formulating appropriate industrial and technology policies and providing funds for research especially that are fundamental in nature (with no obvious commercial application). Higher education sector plays a critical role in terms of educating and training people as well as performing research that adds to the stock of new ideas in the economy. Whilst the importance of academia is well acknowledged in the NSI, it argues for a limited role for the university system in terms of commercialising its research output (Freeman 1995, Nelson 1993, Lundvall 1992). As Mowery and Sampat (2005) points out, the way the role of university is conceptualised in NSI makes it open to the charge that it subscribes to a ‘liner model’ of innovation where ideas and prototypes are formed in research laboratories by scientists and inventors, which are then taken up by others who then proceed to commercialise them. NSI theorists (Nelson 1993, Freeman 1995) themselves have acknowledged the influence of Vannevar Bush who developed in 1945 the ‘blueprint’ for the post war United States R&D system through his publication ‘Science: The Endless Frontier’, where he stressed the role of universities in bringing forward a continuous stream of new ideas to the marketplace and saw this as the principal mean of retaining the technological edge of US over other nations. The ‘linear model’ has been the subject of influential debates by scholars, some of whom have argued that innovation in reality rarely follows this pattern (Kline and Rosenberg 1985). Rosenberg (1994) in particular has forcefully argued for the serendipitous nature of invention and innovation where the inventor often is not aware of how the invention will ultimately be commercialised and used. Notwithstanding such critiques, NSI and the conception of the role of university therein have gained wide acceptance both amongst scholars and policy makers in recent times.
Triple Helix Model

Triple Helix Model (hereafter THM) came as a reaction to NIS and in particular to the division of labour as specified in it. Etzkowitz and Leydesdorff (2000) argue that a nation or a region gets more innovative as the roles of government, industry and the academia overlap with each other. Embedded in the theory is also the idea that circulation of people within the three spheres help learning and thus contribute to the innovative capacity of the nation (Etzkowitz and Dzisah 2008). There are obvious similarities between NSI and THM. Both frameworks take an institutional perspective to explain innovation dynamics and both acknowledge the key economic actors, which are government, industry and university, within the system. But there are important differences between the theories, especially on the role of the university and its relationship with other actors within the system and this particular difference has been analysed later in the section.

THM is more normative than NSI, in the sense that it prescribes one preferred model of university industry government linkages. THM (Etzkowitz and Leydesdorff 2000) suggests that there are three possible models for such linkages. First, it is possible that in a society university and industry are overwhelmingly put under government control, a ‘Statist’ model, where there is little manoeuvrability for academia and industry, both of whom become highly regulated. Second, a ‘laissez-faire’ model can be implemented, where there are strong boundaries between government, industry and academia and each institutional actor do not venture in the others’ turf. Third and the preferred model is the ‘Triple Helix’ where there are strong overlaps between the roles of the three institutional actors with each taking up the others’ role in varying degrees. In this scheme, universities become more entrepreneurial while industry gets more involved in delivering higher education and training. THM suggests that policies should be directed to replicate this model across societies.

Role of university in THM

THM is explicit in its advocacy for entrepreneurial university (Etzkowitz 2003). It emphasises the ‘third mission’ of the university, that of direct contributions to the industry, others being teaching and research. The cornerstone of THM is the belief that universities should be at forefront of innovative activities and be active partners in commercialising its research output. The Bayh -Dole act of 1980 in United States which gave US universities control of their invention and other intellectual properties is considered by THM scholars as a watershed as far university entrepreneurship is concerned. Such regulatory action is considered necessary in providing the incentive to university to engage in entrepreneurial action. Drawing from experiences of US universities such as MIT, Stanford and University of California, Berkeley, THM argues that US universities became more entrepreneurial after enactment of the act leading to more patenting, licensing, and spin off activities out of their intellectual properties. Such activities are seen to be a measure of increased innovative capacity of universities in particular and of the nation in general.
National Innovative Capacity

National Innovation Capacity (hereafter NIC) is a framework which synthesises three distinct theoretical concepts. These are endogenous growth theory (Romer 1990, Nelson and Romer 1996), the concept of NSI (Freeman 1995, Nelson 1993, Lundvall 1992) and cluster based theory (Porter 1998). The framework attempts to specify the determinants that affect the innovation process which in turn results in innovation output in varying degrees across different countries (Furman et al 2002). NIC is seen as a country’s potential to produce commercially relevant innovations and this in turn is dependent on variety of factors including human capital and financial resources available for R&D activity, level of technology sophistication, intellectual property protection, and related and supporting industries. The endogenous growth theory explicitly links the stock and quality of the human capital in a country to the level of technological sophistication it possess and consequently the rate at which its economy grows. Technological changes are not seen exogenous to the model but endogenous, or in other words, such changes comes through the process of carrying out normal business operations that includes R&D activities and through up-gradation of the skill level of the labour force that allows them to be more productive and creative. As NIC builds on NSI, not surprisingly there are many common elements between the two theories- both frameworks stress the importance of R&D and the necessity of having supporting institutional structures that includes protection of intellectual property rights. However NIC consider these as necessary but not sufficient conditions for development of innovative capacity of countries. The other key variable that the theory identifies is the notion of ‘cluster’. Drawing from Michael Porter’s earlier work, Porter and Stern (2002) incorporates the cluster idea into NIC to bring into forefront the role of competition that they consider central in the innovation process. Clusters, being geographical concentration of interconnected companies and institutions in a particular field, ensures availability of high quality specialised inputs and creates a “a context that encourages investment coupled with intense local rivalry, pressure and insight gleaned from sophisticated local demand, and the local presence of related and supporting industries” (Porter and Stern 2002: 6) and developing this kind of environment is crucial for improving the innovative capacity of nations. The most well known example of cluster in the US is the Silicon Valley that has produced many high technology companies some of which have eventually grown into multi billion dollar enterprises. The success of Silicon Valley has been attributed to the network of institutions that underpin it which includes world class universities such as Stanford University, strong protection and enforcement of intellectual property rights, availability of risk tolerant venture capital and angel funding, a culture of entrepreneurship, and strong social networks of knowledge workers. NIC advocates for the Silicon Valley model to be replicated elsewhere to promote innovative capacity of regions and nations. It needs bearing in mind however that Silicon Valley is a product of history; much of original investments in the region was related to the defence industry and was state sponsored which in turn was a consequence of the Second World War and the Cold War (Kenny and Burg 1999). Though NIC serves as a good model to explain the
innovation dynamics in regions such as Silicon Valley, it is less useful in providing a roadmap to how such a configuration can be arrived at in a different context.

Role of university in NIC

NIC highlights the importance of skilled labour that is capable of carrying out R&D activities. It explicitly cites investment in education and training as one of the key determinants of innovative capacity of the nation. In this respect it is similar to NSI but there is a distinction in the emphasis that is put on R&D in the two approaches. In NSI, universities are seen as institutions that not only produce skilled manpower but also act as a generator of original ideas and inventions that are ultimately commercialised by private firms. In contrast, NIC while acknowledging the importance of university for its contribution to development of human capital underplays its direct role in the innovation process. NIC accords the leading role in innovation of new products and services to business organisations who invests in R&D motivated by fear of losing market position through competition and secured in the knowledge that such investments will be protected through intellectual property rights. University’s role in this scheme is an indirect one- it trains the scientists and engineers who ultimately work in R&D labs of business organisations but it is otherwise a largely passive entity in the innovation process.

Mapping the patterns of U-I-G linkages described in the three theories:

As can be discerned from the discussion above, NSI, THM and NIC have their individual distinctiveness in terms of explaining innovation dynamics in nation states. Notwithstanding this uniqueness, the three theories also cover some common grounds. Table 1 denotes both the exceptionalities and the similarities amongst the three concepts. It should be noted here that this attempt is necessarily an exercise in reductionism as the purpose is to bring forward the essence of these theories and it is well acknowledged that the theories are more rounded than what it may suggest in this encapsulation.

All the three frameworks acknowledge the importance of the academia in a nation’s innovation system albeit with key differences in the conception of its roles. NSI and THM finds a direct role of the academia in the innovation process, with the former looking at it as a co-generator of new ideas along with the industry and the latter advocating a even more active role in terms of commercialising the ideas it generates. NIC in contra distinction looks at the academia playing an indirect but nevertheless key function of educating and training the labour force, especially the future scientists and engineers who when employed by the industry directly participates in the innovation process.

In the next section, the case of India is presented with the objective to compare and contrast the empirical reality of the role of higher education system in India in its innovation system against the patterns of such linkages as mapped by NSI, THM and NIC.
The Case of India

The purpose of the case study is to trace the evolution of the higher education system in India and its inter-relationships with the State and the Industry. Contrary to conventional accounts of the higher education sector in India, this case study focuses both on pre and post independence period rather than solely focusing on the latter. It is felt that some aspects of the higher education sector in India can only be properly understood if one takes its colonial past into account. The case study highlights some of the path dependent issues that can be hindrances for the university sector in building beneficial linkages with industry and government as it is felt that an appreciation of these issues will make for better policy making. Moreover, the study also endeavour to illustrate in what important ways India’s case conform or deviate from the pattern specified in various system theories of innovation.

The University system in India was set up in imperial British India in 1857. The university system in India was based on the University of London model, in which the university did not carry out any teaching and research but rather focussed on examination of students that were educated in affiliated colleges. Notably, shortly after 1857, University of London itself went a major change, removing the requirement of affiliation and opening up its educational system to the wider public. Also while University of London had affiliation with colleges such as UCL (University College London) and King’s College-institutions that had a track record for excellent teaching and research-, colleges that were affiliated with Universities in India lacked such credentials due to perennial lack of financial resources, as they were mainly run through individual initiatives and did not enjoy state support. Notable exception to this pattern was the Presidency College in Calcutta that traditionally enjoyed patronage from the government. In this situation, ideally the State should have intervened to promote teaching and research within the university system but throughout the colonial era, government support towards higher education remained lukewarm. The situation did not change till early twentieth century and then only post graduate teaching was gradually introduced. Research was an aspect that was severely neglected within the university system during the imperial period. Scientific research during this period was fostered mainly through native efforts outside the university system. From late nineteenth century onwards local intelligentsia too the initiative in developing scientific research capability in the country by establishing institutions such as the Indian Association for Cultivation of Science (IACS) that did basic research but hardly any teaching. In fact, IACS produced India’s only Nobel laureate in physics till date, C.V Raman who did his pioneering work as a researcher in the institute for which he was awarded the Nobel Prize in 1930. Scientific research by native Indians in the pre independence period became increasingly interlinked with cultural issues such as the matter of national identity (Lourdusamy 2004)

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1 The case study has been developed through a combination of secondary data sources including archives and primary data collected through semi structured interviews conducted by one of the authors. External data sets have been used and cited accordingly. Over twenty semi structured interviews were conducted with various academics in India who are involved in industrial partnerships.
with a focus on basic research rather than applied. The attempt was to demonstrate to the imperial rulers that native scientists were more than capable of carrying out original work in their respective fields and thus simultaneously extend the cause of nationalism and gain social acclaim both at home and abroad (Loudusamy 2004). There were two implication of this situation. First, it produced a defining characteristic of the Indian higher education system- the separation between teaching and research. The university system that started as purely an examination body slowly evolved to a teaching institution but the emphasis remained on the earlier function of examination and teaching was undertaken almost an afterthought. For the imperial British government, the Indian university system served a key function, which was to provide the human capital required to run institutions that were central to the colonial enterprise such as judiciary and civil service. Throughout the colonial era, the bulk of the graduates from the university system were professionally employed as lawyers and civil servants. As an example, during the period 1871 till 1882 the university system produced 3,311 graduates of whom 1,244 entered government services and 684 joined the legal profession which together constituted almost sixty percent of the total graduates (Hunter 1883). The main requirements from this labour force were mastery of the English language and English legal code that were both transplanted on India by the British. University examination was the main instrument through which the proficiency of native Indians to perform in public services was assessed hence its eminence in the colonial era. Teaching was lower down in the priority list and original research even lower down.

In response to the state apathy towards scientific research, native Indians took the initiative to build indigenous research institutions like IACS that were outside the formal university system. Such institutions never became part of the mainstream higher education system in the colonial era and they suffered from a constant lack of resources, yet these research institutes produced a template for doing research outside the boundaries of the formal university system, which would be followed in the post independence period albeit for different reasons.

What is notable in the colonial period is the lack of any substantive interaction between the university and the industry. The university sector, as highlighted already produced a labour force that was employable in judiciary and civil service and not much anywhere else. British government and industry imported technology from the metropolis wherever required and there was no effort to transfer any technical knowledge to the colony. Indigenous industry stood the most to benefit from technical knowledge from the university sector but found little such support. Jamsetji Tata, who is regarded as one of the pioneers of Indian industry, whose legacy includes several multinational companies of the present day including Tata Steel and other Tata Group companies, was so frustrated with the lack of contribution from the university system that he helped in setting up of Indian Institute of Science (IISc) with the hope that the institute will fulfil this vital role. After India’s independence and over the years IISc has emerged as the premier research based institution in India and has played a pioneering role in forging fruitful relationship with the Indian industry. Before independence however notwithstanding some sporadic efforts, the interaction between university and industry remained severely limited.
It is illuminating to contra-distinct the university industry relationship that one observes during the colonial period between 1857 and 1947 in India with that in Britain. It was during this period industry university linkages flourished in Britain with the establishment of several civic universities such as University of Manchester, Bristol University, and University of Leeds amongst others (Sanderson 1972). Many of these universities were set up by industrialists who appreciated the potential for such institutes to create and store scientific and technical knowledge which then can be applied in the service of the industry beside its more obvious function of supplying skilled manpower. As Sanderson points out, while the industrial revolution was not brought about by university scientists, once it was entrenched in the economy it created the need for skilled labour who were specialist in their area. For example, University of Leeds developed excellence in three fields of industrial chemistry. It developed expertise in chemistry of leather which was used for tanning and dyeing in the leather industry that flourished around Leeds in late nineteenth century. The university also had expertise that served the needs of the gas industry and had Britain’s first university department of coal gas and fuel industries by 1907 and finally the university also specialised in tinctorial chemistry that was applied to the textile industry (Sanderson 1972).

In India, similar university industry linkages were lacking as the Colonial government imported technology in a wholesale fashion to develop services like the railways which had the potential to industrialise the economy but failed to do so. Here the university system was run by the State for the purpose of running the imperial enterprise and thus it was funded by the colonial government and the scope and day to day operations of the sector were guided solely by it. The system produced lawyers and civil servants in abundance but few engineers and scientists\(^2\). At the end of the colonial period in 1947, there were 21 universities in India. Teaching by this time had been introduced to most of the universities although three amongst them remained purely examination bodies while research activities within the university system remained severely limited\(^3\).

Another point of difference between the British and Indian university system in the colonial era was the diversity of university models. In Britain, the students had many different types of university models to choose from- the Oxbridge model which focused on liberal studies, the Scottish universities like St Andrews and University of Edinburgh, that had a strong tradition of teaching and research, the ‘civic’ or ‘redbrick’ universities like University of Leeds, Bristol University and Liverpool University that were established in the industrial towns of England and which focused on technical education and of course the examination based university education of University of London (circa 1836-1900). While in India, the only choice was the examination oriented system. This lack of diversity in higher education models directly affected the sector’s ability to interact with the industry. While in Britain, the ‘civic’ universities along with UCL and

\(^2\) During the period 1871-1882, the university system produced only 53 engineering graduates, less than 2% of the total graduates (Hunter 1883)

\(^3\) For a detailed historical perspective on the university system in India in the colonial period see ‘Report of the University Commission (December 1948-August 1949) 3 Vols. New Delhi: Ministry of Education, Government of India, 1963
King’s college specialised in technical education and developed close linkages with the industry, lack of such university models in India severely limited the sector’s ability to contribute effectively to the needs of the local industry.

As India gained its independence in 1947, the apathy of the State towards research, both basic and applied, not surprisingly changed. India’s first Prime Minister Jawaharlal Nehru strongly felt that it is industrialisation alone that could drag the country out of poverty and into prosperity. However in a decision that had far reaching consequences, the first government of independent India decided to keep the boundaries of the university system largely intact\(^4\) and focused on research on science and technology through institutions that were largely outside the higher education sector. Many publicly funded research institutions were set up to carry out basic and applied research but these institutions did not carry out any significant teaching or training of students. Beside this, engineering institutes such as Indian Institute of Technology (IIT) were set up that were outside the university system and enjoyed greater autonomy than that was accorded to the universities. The separation between teaching and research which started in British India now became permanent feature of the academic landscape of India.

The university sector in India has grown significantly over the years after independence. At present there are 259 State Universities, 42 Central Universities, 130 Deemed Universities, and 65 private universities which are affiliated to different states (provinces)\(^5\), beside having number of autonomous higher education institutions such as IIT and IIM (Indian Institute of Management) that are labelled as institutes of ‘national importance’.

These impressive numbers however masks several problems of the higher education sector in India. First is the difference that exists between the ‘State’ universities and ‘Central’ universities. The distinction is a vestige of the colonial past when different provinces were acquired as the British expanded its empire in India. For example, the first universities were established in 1857 in the three provinces- Calcutta, Madras and Bombay, where the British exercised its control. As the empire grew and new provinces were brought under British India, new universities kept being added to the fold and governance of these universities were responsibility of the provincial governments. Surprisingly, the first government of independent India chose to keep this provincial structure largely intact and thus universities in India came to be mainly under the jurisdiction of state (provincial) governments rather than be under the control of government that is at the centre. The federal structure of the government of India in which some aspects of governance is delegated to different states (or provinces) meant that this structure was a feasible one but the real question is whether it was desirable?

\(^{4}\) Ibid
\(^{5}\) Information gathered from the University Grants Commission (UGC) website at [http://www.ugc.ac.in/](http://www.ugc.ac.in/). This is where the most reliable and latest figures are available. Readers should note that the university sector in India is at present undergoing rapid changes as new universities are founded and some old ones of dubious character are shut down by the UGC on a fairly frequent basis.
It is clear that policy makers themselves felt that there is a need for universities where control is exercised at the centre rather than at the provincial level, hence the establishment of several ‘central’ universities and over the last sixty three years after independence, it is the central universities in India that have been better financially endowed, enjoyed better governance and taken the lead in research and development activities (Dahiya 2001). But as the State universities vastly outnumber their Central counterparts, issues of poor governance and narrow outlook that arises out of provinciality remains key issues for the university sector in India.

Another key challenge and one that is interlinked with the distinction between State and Central universities that has already been discussed, is the issue of autonomy of the universities. The lack of autonomy for universities and how it has led to falling standards within the higher education sector has been discussed widely (Dahiya 2001, Kanhere et al 2009). The system has been exclusively under the government control since its inception in British India and moreover, the situation got more complex after independence as state governments’ agenda relating to university operations often differed to that of the central government thus contributing to the conflicting tensions that exist within the sector in the present time. The governance of State universities is carried out through a separation of duties between state and central government. While University Grants Commission (UGC) which is a central body is responsible for grants-in-aid from public funds to Central and State universities (including Deemed universities) and also for maintenance of standards, the states are in charge of operations of the State universities including appointment of administrative and academic staff, setting up of curriculum, direction of R&D activities and interactions with industry. One issue that is highlighted out in the context of State universities in India is the lack of research activities that one witness in these institutions (university in general contribute around only 4% of total R&D spending in India (see Figure 1 for a break-up of R&D spending). From the perspective of state government there is little incentive for using the public funds received from UGC for research purposes as it is difficult to link such spending to direct betterment of provinces though the nation as a whole would benefit from the investment through spill over effect; far better measurements of performance for State universities therefore are the number of students being taught, examined, and graduated. For this reason, there is a strong case for research activities to be channelled and directed at the central level rather than at the provinces.

The third challenge and the most critical one facing the higher education sector in India is the constraint of financial resources. Despite the impressive economic growth that India has registered over the last two decades, it still remains largely an agrarian economy with fifty percent of the work force employed in the agricultural sector. Adult literacy rate is only at sixty five percent and gross enrolment ratio in higher education stands at thirteen percent much below China’s twenty five percent (an economy that is comparable to India in terms of population). India’s per capita income in 2009 stood at US$ 1,120 compared to Britain’s US$ 35,165 and USA’s US$ 46,436. It is not feasible for India to

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7 World Development Indicators database, World Bank. Accessed on September 10, 2010. Note: Per capita values were obtained by dividing the Total GDP data by the Population data.
make the massive state investments in research and development that produced research led universities in the west such as MIT, University of California, Berkeley in the US or University of Cambridge in Britain, whose intellectual properties—a consequence of such investments—attracted industry to their doorsteps.

The nature of interactions between university and industry in India has changed significantly over the years. In the colonial era there was little interaction between the two, as the university system essentially supplied the human capital to staff the civil service and judiciary. Post independence, the graduates of Indian university system found employment in a much wider range of careers including in the Industry. Other forms of university-industry linkages such as industry sponsored research projects, joint publications of scientific articles, business incubators in universities, has started to flourish only recently in certain institutions such as Indian Institutes of Technology (IIT) and Indian Institute of Science (IISc). These institutions have witnessed higher intensity university-industry linkages. For example almost all the business incubators that have been started in academia in India can be traced to the IITs and IISc. These institutions have also been the main recipients of industry sponsored projects albeit still quite small in number. It is important to note that it is this class of institutions, that are outside the formal university system and are often labelled as ‘Institute of National Importance’ enjoy relatively greater autonomy (see Table 2).

Research output within the formal university system has been traditionally very low (see Figure 1) and this situation is due to both lack of research funding and a dearth of incentive for staff to engage in research. Much of the government funding in research, which is by far the largest part of the total R&D spending in India, is channelled through public research institutes which in general, do not engage with teaching and training. Within the academia, it is again the semi-autonomous institutes such as IIT, IIM, ISI (Indian Statistical Institute) and IISc that are leading the way in research with IISc currently ranked as the top institute in term of its research output within the technological and engineering institutes in India (Prathap and Gupta 2009). ISI also publishes the acclaimed journal ‘Sankhya’ in statistics, which is one of the few academic journals that India produces that enjoys a wider international reputation.

**Autonomy in universities and the way forward**

What emerges from the previous discussion is the strong connection between autonomy that is enjoyed by a particular class of higher education institution and the intensity with which it participates in the nation’s innovation system. The relative higher autonomy enjoyed by IIT, IIM, IISc and ISI has directly led to greater partnerships with the industry and a higher research output. The government of India also in recent times have acknowledged the link between autonomy of universities and its performance in the innovation system. It now proposes to set a new class of universities in India appropriately named ‘Innovation Universities’ thus explicitly recognizing the fundamental role that University play in its innovation system. The key feature of this new genre of universities (the proposal is to set up initially 14 of these) is the greater
autonomy they will enjoy in comparison to the present universities. The *Concept Note* of the government emphasise that these universities will have ‘autonomy in matters of academics, faculty, personnel, finances, administration and in the development of a vision for the future.’

The ‘Innovation Universities’ will also not fall under UGC and thus will be free from its bureaucratic controls. It is planned that the universities will be private in nature and each will have a ‘university endowment’ to enhance the research infrastructure of the university and the universities will be free to receive donations, contributions from its alumni along with other incomes.

The proposal is at present tabled as a parliamentary Bill and is yet to be cleared by the Indian polity but it is undoubtedly a step in the right direction in making the university system a more active participant in the country’s innovation system.

**Does India’s case fit the pattern?**

It is clear from the case study that the contours of India’s university system has been shaped by historical events much like it has been the case with Britain and USA. However in contrast with these Anglo Saxon economies, India’s past has led the university system to the present time when it is overwhelmingly under government control, and bifurcated into a three tier higher education consisting of Central universities, State universities and autonomous institutions of ‘national importance’. While the autonomy and R&D is severely limited in State universities, it is slightly less so in Central universities. Autonomous institutes such as IIT and IISc enjoy greater degree of autonomy and have been more successful than the traditional universities in both R&D and developing interlinks with the industry (see Table 2). Private universities have only recently been allowed to operate in India but are yet to make an impact in the higher education sector.

It is important to note that while historical events such as the First and Second World War brought universities, industry and state in close contact with each in USA and in Britain, in India’s case, its colonial past restricted the scope of interaction with the industry. After independence, the situation did not improve as the first government of independent of India retained much of the colonial university structure and channelled R&D effort through public research institutes that did research but little teaching. Universities thus did not get the opportunity to develop close inter-linkages with the industry as they had little intellectual property that they could offer to the industry and lack of autonomy hindered any effective partnerships that could have been developed.

To relate India’s experience with the various system theories of innovation thus possess a challenge. At a descriptive or positive analysis level, these theories does not perform adequately, as apart from supplying skilled manpower to the industry, the universities

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*Concept Note on Innovation Universities Aiming at World Class Standards.* Retrieved from [http://www.education.nic.in/uh/Universitiesconceptnote.pdf](http://www.education.nic.in/uh/Universitiesconceptnote.pdf) on 28/10/10 p.10
perform little else that conforms to the pattern of activities depicted in the concepts of NSI, THM and NIC. NSI stress, for example, that university sector is the platform through which public expenditure on R&D is or should be channelled through. There is little evidence of this in India. THM advocates that universities should take an entrepreneurial role, fostering business incubators and developing other forms of active partnerships with industry. There is little evidence of this as well within the traditional university sector. NIC focuses on industry as engine for innovation but stresses the core function of the university in creating strong cohorts of scientists and other R&D personnel who can then be employed by the industrial sector for research activities. It uses patents and formal R&D expenditure as the measurements of innovation activities. The industry sector in India fares poorly on both accounts. Majority of Indian R&D expenditure is by the public sector through publicly funded research institutes.

One way to explain India’s case can be to cite it as an example of a failure- a context where one does not witness the ‘normal’ interactions between university, industry and the state and this can argued as the reason for lack of ‘innovation’ in the society as represented by minimal investment in R&D especially by the industry, and low patent rate. But this reasoning will be indeed odd as India has enjoyed spectacular economic growth over the last two decades and it is now a fairly well established economic assertion that such long term growth comes primarily out of innovation.

The question how innovation is occurring in India is beyond the scope of the paper which is limited to looking at the role of the university in the process. Nevertheless, it has been shown elsewhere (Datta and Saad 2008) that India’s economic success story is based on growth in business services, including information technology services that are mainly non patentable and which does not require formal R&D spending.

**Unconventional contributions of the academia**

The higher education sector has also helped the industry in ways that are not captured in the frameworks of NSI, THM and NIC but which becomes apparent when one converses with the academics and their industrial partners. One of these ‘different’ contributions is the way the higher education sector or at least a part of it helps the industry to recruit its personnel. Campus recruitment, which is, hiring of students as staffs while they are at the final year of their study, is really big in institutions such as IIM and IIT. These institutions through their merit based entrance exam system and continuous evaluation of students throughout the programme ensures that when the time comes for recruitment by the industry, the recruiters can cherry pick amongst the best of the lot. In other words, these institutes reduce hugely the information asymmetry that faces the potential recruiters. The industry is then spared the effort of carrying out their own tests to evaluate the merit of candidates.

Another way the higher education sector has contributed to the economic success that India has enjoyed in recent times is through creation of strong alumni networks of its graduates that have been instrumental in attracting Diaspora investments into the country. The most celebrated of such networks is TiE or The Indus Entrepreneurs which originally
constituted of IIT graduates in the Silicon Valley but which now has expanded to include all kind entrepreneurs from all over the world. TiE has been instrumental in forging closer industry links between India and USA especially in the IT sector.

These are just two examples of how the higher education sector in India is developing linkages with the industry both within and outside of the country and in ways that are generally neglected in the scholarly discussion surrounding university industry linkages. It is suggested therefore, that there is a need to critically evaluate the theories of NSI, THM and NIC before applying them in a very different context, such as in the case of India, from the ones where these concepts originated from. Undoubtedly these theories contain some valuable insights that can be of use to policy makers in India and in other developing countries. As has already been commented upon, the strong inter-linkages between university and industry that one witness in USA and in Britain may have been shaped by historical events but once in place they provide strong impetus to innovation within the society and consequently contribute to economic growth. But for policy makers in developing countries it is critical that they are aware of the path dependent issues that risen due to their own historical past before trying to formulate a plan to overcome these hurdles and encourage closer interaction between the government, industry and the university. To some extent, the government is attempting to achieve this by creating a new class of universities in India that will enjoy a greater degree of autonomy in academic and financial matters. It is important to note that the government is trying to foster a deeper linkage between university and industry through a new genre of universities rather than trying to reform the existing ones. This is perhaps because the inertia that has developed in the traditional university system in India over its long history is too difficult to overcome and it is more sensible to start afresh with none of the outdated and obsolete institutional practices to cater to. Only time will tell if the government succeeds in its efforts but the model is one that can well be extended to other developing nation contexts.

**Conclusion**

This paper by mapping the different roles for university, industry, and government as prescribed in theories of NSI, THM and NIC has highlighted the key differences and similarities that exist within them. Through the case of India, some of the challenges that lie in application of these theories to a developing country context have been analysed. University industry linkages in India, as is the case with developed economies, have been influenced by historical events, none more so than its colonial past. It has been found that the pattern of university industry linkages in India differ considerably from that in Britain and USA. This however does not imply that higher education sector in India do not share meaningful inter-relationships with the industry or that they do not contribute to the innovative capacity of the society- just that they do these in ways that do not fit the ‘normal’ pattern witnessed in developed economies. Theories such as NSI, THM and NIC can provide valuable insights to policy makers in developing countries such as in India, who are interested in developing innovative capacity of their societies and making universities a more potent instrument for fulfilment of this goal. However, the challenges
that lie in the way can be properly appraised, if they take into account the path dependent
issues that may have risen due to historical events that are specific to their society.

<table>
<thead>
<tr>
<th>National System of Innovation</th>
<th>Academia</th>
<th>Government</th>
<th>Industry</th>
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<tbody>
<tr>
<td>1. Conducts both basic and applied research with emphasis on the former</td>
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<td>2. Educate and train students thus raising the stock of human capital in the economy</td>
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<tr>
<td>3. Direct role in innovation process by being originator of new ideas and products through research</td>
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<tr>
<td>1. Funds basic research carried out through academia</td>
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<tr>
<td>2. Frames appropriate S&amp;T policies to create an innovation infrastructure</td>
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<tr>
<td>3. Design appropriate ‘rules of the game’ to facilitate learning between academia and industry</td>
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<tr>
<td>1. Commercialise ideas that are generated in the academia</td>
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<tr>
<td>2. Engages in applied research through formal R&amp;D</td>
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<tr>
<td>3. Improves products and process through incremental learning and strong competition</td>
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<tr>
<th>Triple Helix Model</th>
<th>Academia</th>
<th>Government</th>
<th>Industry</th>
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<tbody>
<tr>
<td>1. Becomes more entrepreneurial</td>
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<tr>
<td>2. Engages in patenting, licensing, business incubating and university spin offs</td>
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<tr>
<td>3. Assumes active role in innovation process by being both creator of new products and commercialising them</td>
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<tr>
<td>1. Plays a facilitating role to promote entrepreneurial activities of the academia (ex. Bayh Dole Act)</td>
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<td>2. Design appropriate policies to facilitate overlapping of roles between university and industry and itself</td>
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<tr>
<td>3. Create the condition for circulation of labour between the three institutional spheres</td>
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<td>1. Develop close relationships with the academia in several fronts</td>
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<td>2. Increasingly take over sponsorship of research conducted at the university replacing government funding</td>
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<tr>
<td>3. Get directly involved in education and training of the workforce</td>
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<tr>
<th>National Innovative Capacity</th>
<th>Academia</th>
<th>Government</th>
<th>Industry</th>
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<tbody>
<tr>
<td>1. Educate and train the workforce thus raising the stock of human capital</td>
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<tr>
<td>2. Focus on training scientist and engineers as they form the core which ultimately produce the flow of new ideas in the economy</td>
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<tr>
<td>1. Create appropriate incentive structure in the economy that encourage generation and commercialisation of new ideas (ex. IPR protection)</td>
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<td>2. Design policies to develop a strong competitive environment which includes ‘clusters’</td>
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<tr>
<td>3. Invest in higher education to ensure that the stock of human capital in the society is maintained and enhanced</td>
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<tr>
<td>1. Acts as the primary engine for generation and commercialisation of new ideas, products and processes</td>
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<tr>
<td>2. Undertakes the majority of forma R&amp;D spurred on by competition and by the fear of losing market share</td>
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<tr>
<td>3. Contributes to cluster formation</td>
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</table>

Table 1: Mapping of University-Industry-Government Linkages

Mapping the role of academia in the innovation system of India
Table 2: Mapping the role of academia in India’s innovation system
* Private Universities have only recently been allowed to set up in India and hence do not have a track record in industry partnerships and research

![Figure 1: Pattern of R&D Expenditure in India](chart-image)

References


