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Does India need a Bayh-Dole type Act? - Misplaced Priorities in STI Policy

T. Jayaraman
Center for Science, Technology and Society
Tata Institute of Social Sciences

Paper prepared for the International Conference on Science, Technology and Economy
Organised by the Forum for Global Knowledge Sharing (FGKS)
and the Tata Institute of Social Sciences
9th -10th October, 2009, Mumbai.

Introduction:

In the last days of the previous government, the Ministry of Science and Technology put out for discussion a draft version of a bill that proposed an Indian version of the well-known Bayh-Dole Act of the United States. This bill, titled ``The Protection and Utilization of Publicly Funded Intellectual Property Bill, 2008" is closely patterned after the original U. S. legislation which inspired it. It proposed to bring the results of publicly funded research in institutions in India under the purview of intellectual property rights legislation. Specifically it proposed to make mandatory the review of all publicly funded research for potential IPR coverage and subsequent patenting for research that met the relevant criteria. It also proposed mandatory punitive action in case suitable research was not patented, together with the outlines of a mandatory review structure to ensure the implementation of the proposed legislation. The proposed bill brought under its purview all institutions that received public funding for research activity.

In this paper we study the relevance and significance of this proposed legislation in promoting innovation in the university and publicly funded institutions research sector in India. We begin with a brief review of the origins of similar legislation in the United States and the impact that the Bayh-Dole Act has had on research and innovation in that country. We also briefly discuss the extension of similar legislation to other developed nations. We then turn to the current state of research and innovation in this country and briefly account for some its key characteristics. In a third section we turn to a detailed examination of the proposed legislation and its likely impact based on the proposed text, read together with the international experience with such legislation as well as some current issues in research in the university sector. The paper ends with a review of the main conclusions.

The Bayh-Dole Act and its impact:

(*a) A Note on its origins*:

The Bayh-Dole Act was passed by the United States Senate in 1980. The Act was enacted with the stated purpose of encouraging universities conducting publicly-funded research to patent their discoveries and inventions and to license these, even in exclusive arrangements, to private firms for suitable commercial exploitation. In particular there was no obligation on the part of the universities to seek avenues of non-exclusionary licensing.

Prior to the passage of the Act, most universities in the United States were not directly involved in promoting patenting of the products of basic research conducted by them or managing the licensing of their patents for the purpose of developing the resulting income.[1] In the main, the decision to patent was left to the individual scientist concerned. However many universities had arrangements whereby the management and administration of the patents were handed over to a third-party. Thus the main actors involved in IPR protection of university research and their main beneficiaries were the individual scientists and the third-party administrators with the universities playing no central role. Nevertheless the universities did receive a share of the income from the licensing of patents. As noted by Sampat, there were broadly two different kinds of institutional frameworks within which these third-party administrators were related to the institutions whose patents they administered, but this difference is not of much relevance to our considerations here.

The bulk of the patents held by U.S. Universities until the 196 0s were not the result of federal funding, a situation that subsequently underwent considerable change. While in the earlier stages,

1 For a useful review, on which this section draws heavily, of pre-Bayh-Dole policies of universities with regard to patenting of university research and the runup to the legislation, see for instance, Bhaven Sampat, ``Patenting and U.S. Academic research in the 20th century:The world before and after Bayh-Dole", Research Policy, Vol. 35, pp. 772-789, 2006.

many federally funded research programs did not allow the grantees to retain title to any of the research products, this position was gradually eroded. By the 1970s, in the case of several federal departments that funded research, universities increasingly acquired the right to patent the products of their work through specific Institutional Patenting Agreements.

It is significant that one of the precipitating factors for the passage of the Bayh-Dole Act was a developing conflict between the universities that were increasingly broadening the scope of their patenting activity and sections of the U.S. Federal administration that saw the erosion of the `public goods' character of federally funded research as a major issue. It is equally significant, as Sampat notes, that the conflict was openly expressed particularly in the area of funding controlled by the Department of Health, Education and Welfare. In particular, presciently in view of the subsequent global debate on this issue, the Department was concerned about the potential contribution of university research to rising health care costs.

The actual legislative passage of the Act was, as noted by Sampat, a brief affair marked by the domination of small business interests and universities already heavily involved in patenting activity. Though the benefits of the proposed act were confined to small businesses, later administrative actions during the Reagan administration effectively extended the act to all businesses irrespective of size. The arguments advanced in favour of the legislation anticipated later theoretical arguments viz. i) the product of academic research requires considerable further work before they are commercially viable and that this requires the participation of firms that would require clear IPR title as an incentive for such participation and ii) that clarity regarding IPR rights would provide clear incentives for individual scientists and institutions to become more actively involved in the commercial exploitation of their work, thus contributing more effectively to the growth of regional and national ``competitiveness."

(b) Critical overview of impact of Bayh-Dole legislation:

The literature on the impact of Bayh-Dole is varied and both positive and negative impacts of the legislation have been noted. It is uncontroversial that subsequent to the passage of the act, the patenting activity of universities has registered a significant increase. As Sampat notes, there has been a sharp increase in patents granted to U.S. Universities subsequent to B-D (see for instance fig. 3 in Sampat). However the disaggregation of the data provides some interesting results. First, the income from licensing and royalty on university patents by 2002 contributed less than 5% of total research funds at the universities surveyed by the Association of University Technology Managers.[2]

This figure represented gross revenue prior to the deduction of inventor share as well as patent management costs, which could be considerable. Second, the bulk of the revenue accrued to a small section of universities. The AUTM survey cited above noted that 10% of the surveyed universities obtained 60% of the total of such revenues. This could result in the large number of universities that account for the bulk of the low-revenue segment actually losing money through the mismatch between earnings and the costs of patent managment. It is clear from the latest AUTM survey that this broad picture continues to hold valid. Nor have income from patent operations in any significant way replaced other sources of research funding, amounting as it does to no more than roughly 5% of total funding.

In what areas do U.S. universities patent? It has been noted that these are dominated by what Mowery[3] describes as a ``bio-nexus". According to the NSF Science and Engineering Indicators

2 Cited in Sampat op. cit.
3 See Mowery 2002 .

survey[4], the bulk of university patenting was dominated by drugs, bio-affecting and body treating compositions, chemicals in the area of molecular biology and microbiology, organic compounds and surgery alone accounted for almost 37.9% of all patents awarded in 2005. Together with other medical and related chemical and biological areas of patenting the net contribution of the bio-nexus is somewhat higher. However in terms of the total contribution to all U.S. patenting, university patenting has not exceeded 5% in any year.

Thus it is clear that the bulk of the impact of B-D has been to accelerate patenting in areas which were already traditional strengths of university patenting, given the especially close nexus between university research and industrial processes and production in these areas.[5]

However the key issue is whether B-D addressed effectively its original purpose, namely the speeding up of the transfer of the results of university research to effective industrial utilisation and whether the act had also other corollary effects that may have been unintended. The answer to both these issues raise some interesting questions. With regard to the first it is not clear that B-D is the main mechanism or even the most effective mechanism in knowledge transfer from the university to industry. As Sampat notes, there are critical discoveries such as recombinant DNA techniques or other discoveries that are effectively used by industry withut any need to license the related patents. Indeed in these cases, licensing and insisting on payments amounts to opening a route for the university to earn further income rather than promoting technology or knowledge transfer. Similarly, in relation to the second question, the net effect of B-D has been to push universities towards moving `upstream' in the science to technology transfer process, thus increasingly patenting `science ' rather than technology. Recent evidence from patent citations is not conclusive on this issue.

Another area of concern on the impact of B-D has been whether the increasing drive towards patenting of university research blocks knowledge transfer through more traditional mechanisms such as research publications that have been founded on the hitherto ``public goods" character of science. The negative evidence again on this has been anecdotal. But even if knowledge transfer of the codified kind, embodied in published research communications, is not blocked, the benefit of university research that is publicly funded may be blocked by patenting issues. A particular example has been the case of the University of Wisconsin's embryonic stem-cell lines, for which the university has been charging high fees for licensing as well as laying claim to royalties on products developed from these stem-cell lines.[6] These and other related downsides of B-D have been documented in Anthony So 2008.

Clearly patenting of university research in the United States will work in the background of the general functioning of the patenting system in that country. There is an extensive literature that discusses the veritable ``innovation tax" that patenting constitutes in the current mode of functioning of the U.S. patent system that we will not bother to delve into here. It is sufficient to note that the efficacy of the patent system in the United States is by no means an uncontroversial issue. On the other hand, Nelson[7] notes that the United States has a long tradition of collaboration between university and industry, particularly in the areas of agriculture, medicine and pharmaceuticals. As Nelson remarks, ``the universities in the United States were never ivory towers" and that ``patents are not relevant to the story."

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4 National Science Founhdation, Science and Engineering Indicators, 2007-2008.

5 Public Science vs Private Science, Wilson et. al.

6 Anthony So, et. al. , `` Is Bayh-Dole good for developing countries? Lessons from the US experience," PLOS Biology, Vol. 6, issue 10, p. 2078, 2008.

7 Nelson, `` The roles of research in universities and public labs in economic catch-up", in Santangelo ed. ``Technological change and economic catch-up: The role of science and the multinationals", Edward Elgar, 2005.

(c) Bayh-Dole type legislation in other countries:

There has been considerable effort at the introduction of Bayh-Dole type of legislation in other countries, particularly those belonging to the OECD. In the context of our discussion it is particularly useful to consider the efforts to implement such legislation in the European community as it has a research tradition and a pattern of university research-industry interaction that is different from the United States.

In several countries in the EU and at the Commission itself, policy makers have regarded the clarification of clear intellectual property rights as central to the process of improving the interaction between university research and industry. As the European Commission noted enthusiastically : ``'it is vital that knowledge flows from universities into business and society. The two main mechanisms through which the knowledge and expertise possessed and developed by universities can flow directly to industry are the licensing of university intellectual property, and spin-off and start-up companies'' (European Commission, 2003).

However it appears[8] this has often been based on one-sided assessments that have a doubtful empirical basis or do not deal adequately with the downside of the patenting of university research. That the empirical facts of patenting behaviour as understood by policymakers is inadequate as shown by Geuna and Nesta[9]. The low patenting reported from university research, in the form of actual holding of patents by university researchers, is shown to be a consequence of patenting patterns and not as a result of low levels of university-industry interaction. In Italy, France and Germany, university-inventor-involved patents were larger than 2.5% of all university research related patents, whereas directly held patents by university-inventors constituted less than 0.8% of the total. Thus direct comparisons of patenting behaviour between U.S. universities and European universities is not valid even though such comparisons are routinely made by policy makers. There is also wide variation in and varying modifications of the rules governing patenting by university researchers in different countries in Europe (Verspagen 2006). Germany in 2001 changed patent rules to hand over ownership of university research patents to the university rather than individual researchers whereas Italy in the same year moved in the opposite direction.

While a close parallel of the Bayh-Dole act is not particularly relevant at the European Community level, it is clear that the European experience is a diverse one with several attitudes and policy moves in increasing university-industry linkages.

The patenting of university research as one of the means of promoting university-industry interaction has also found an echo in some other major economies including developing countries. China, Korea, Japan, Brazil, South Africa and Malaysia have all legislation in various forms that allows the patenting of university research.[10] However while celebratory accounts often club all these together, there are significant differences in the legislations that have been actually implemented in these various countries. An useful and detailed summary of the current status of aspects of IPR in university research from many countries is provided by Graff[11].

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8 Verspagen, `` University research, intellectual property rights and European innovation systems," Journal of Economic Surveys, Vol. 20, no. 4, pp. 607-626, 2006.

9 Guena and Nesta, ``University patenting and its effects on academic research", Paper presented at the DRUID Summer Conference, 2003.

10 For a full list of Bayh-Dole type legislation in various countries see Helen Davidson,

11 Graff, ``Effects of Bayh-Dole? A survey of IP and technology transfer policies in emerging and developing economies," ch. 3 in A. Kratiger ed. ``Intellectual property management in health and agricultural innovation: A Handbook of best practices, " available online at http://www.ipHandbook.org

The impact of such legislation in these countries is as yet difficult to determine since the relevant provisions are of relatively recent origin. However in cases such as China it is clear that innovation both inside and outside the university have a dynamism that predates the introduction of specific legislation governing property rights on the products of university research.

India's STI policy and the University Sector:

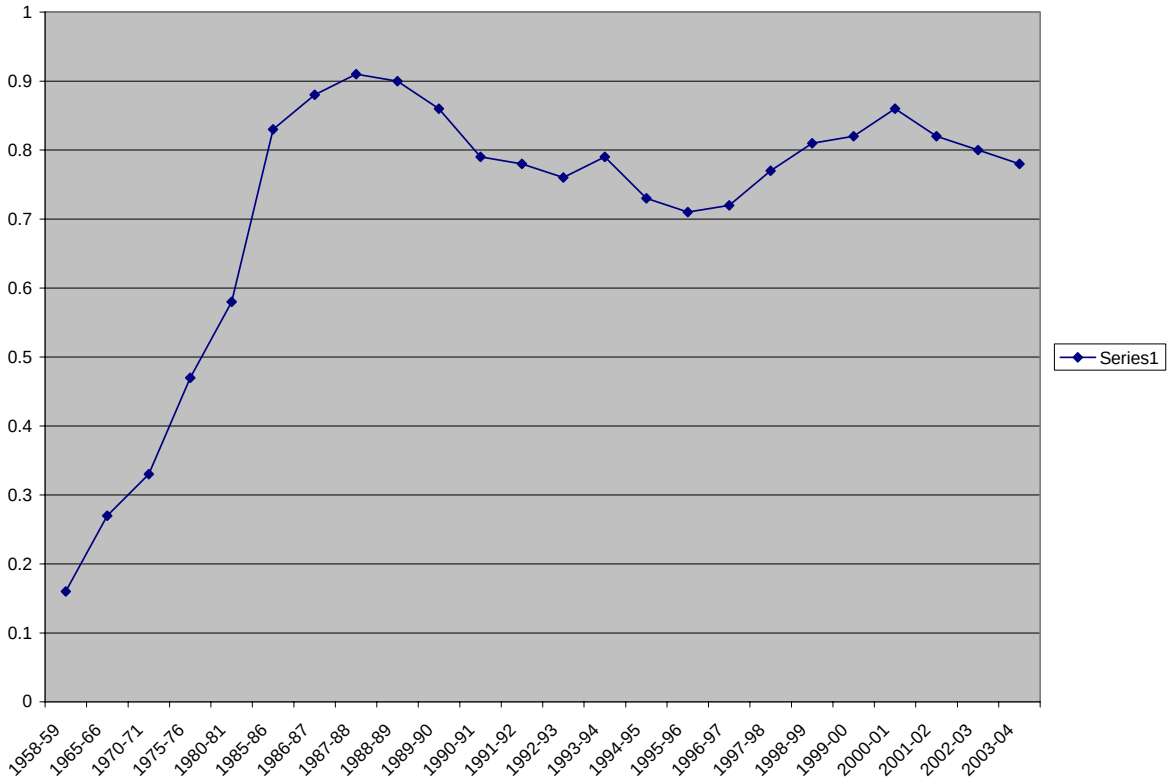
Before we turn to the consideration of the relevance of similar legislation in the Indian context, it is useful to briefly summarize some salient aspects of STI policy and the higher education sector in India.

In India's two-tier research system in the public institution sector, consisting of both institutions devoted primarily to research (with little or no serious teaching programmes) as well as universities and colleges where any research is conducted alongside teaching, it is well-known that the bulk of R&D expenditure is not spent in the university system. According to the Research and Development statistics 2004-2005, published by NSTMIS, Dept. of Science and Technology, Govt. of India in 2005 (R&D 2005) universities accounted for only 4.88% of total expenditure in 2004-2005, rising from 3.04% in 1998-99 as shown in the table below. Even this figure hides the very skewed distribution of this expenditure with institutions like the Indian Institutes of Technology and the Indian Institute of Science, etc. (collectively referred to as Institutions of National Importance (INI)) taking a significant share of the expenditure.

	Government	Industry	Higher Education
1970-71	89.55	10.45	
1975-76	88.13	11.87	
1980-81	84.13	15.87	
1985-86	87.82	12.18	
1990-91	86.16	13.84	
1995-96	78.26	21.74	
1998-99	75.79	21.17	3.04
1999-00	77.21	18.46	4.33
2000-01	77.94	18.05	4.02
2001-02	76.48	19.33	4.20
2002-03	75.56	20.27	4.17
2003-04	75.44	20.05	4.51
2004-05	73.92	19.81	4.88

It is important to read this meagre share of universities as a site of research expenditure in the larger context of two facts. First, India's total R&D expenditure as a percentage of GDP has tended to be relatively stagnant, staying below 1%. [12]

12 Research and Development Statistics, 2004-2005, NSTMIS, Dept., of Science and Technology, Govt. Of India.



Second, there has been no significant shift in the intra-sectoral distribution of R&D expenditure by the Government. With the government being the main source of funding for the higher education sector, this clearly impacts negatively on university research. Government R&D is dominated by the DRDO, the DAE, CSIR, Dept. Of Space and the ICAR, each of whom receives greater than 10% of the total expenditure. None of these though spend significantly on university research as a proportion of their total budgets. The major source of the university research funding, the Dept. Of Science and Technology, Dept. Of Biotechnology and the University Grants Commission together get approximately 10% of the total research expenditure of the government.[13]

While the higher education sector is the source of the human capital required for expansion of STI, the years after the initiation of economic reform in 1992, have witnessed relative neglect of the higher education sector. Expenditure in this sector fell from 0.55% of GDP in 1989-90 to a low of 0.35% of GDP in 1998-99. Subsequently it increased to 0.46% of GDP in 2000-2001.

More significantly, the outturn of highly skilled personnel for STI at the post-graduate and doctorate level grew more slowly than the growth in the number of graduates in sciences, engineering, agriculture and medicine. A number of factors seemed to have contributed by the year 2003-2004 to a fall in the availability of suitable candidates for employment in the scientific research sector. These certainly include the rise of the IT/ITES sector as a significant employer of graduates/post-graduates and the relative unattractiveness of research as a career in an era of relatively high wages in a few emerging sectors, This lack was particularly felt in the scientific agencies of the Central government. From 2004 both the office of the Principal Scientific Advisor to the Govt. of India and the office of the Scientific Advisory Committee to the Prime Minister have been preoccupied by the shortage of qualified entrants to the scientific profession.[14]

13 See discussion in T. Jayaraman, ``Science, Technology and Innovation Policy in India under Economic Reform: A Survey, " 2009.

14 Report of Committee constituted by the SAC-C to examine and recommend New Science Education Initiatives from

The recent expansion in higher education, that began a few years with sporadic announcements and has now been consolidated into a definite programme of expansion of Centrally-funded institutions, owes more to the pressures from sections of the Indian polity rather than as part of a concerted program of expansion of the human capital for STI. Both regional pressures as well as the need to satisfy the pressures generated by reservation for the Backward classes have led to a clamour for more prestigious institutions like the IITs and the IIMs. It is worth recalling that while the scientific community as noted above was concerned by the shortage of a human resources as early as 2004, government action to augment centrally-funded institutions were consolidated much later.

In terms of research publications, the university system has contributed the bulk of all publications from India in the SCIE (expanded version of the Science Citation Index database)[15]. This is a striking fact as it stands in complete contrast to the general negative perception regarding the role of universities currently in India's STI system. As seen from the table below, while the share of university and college in the total number of publications continued to fall, they have nevertheless contributed the bulk of publications from any single sector. In these figures, the contribution of the so-called Institutes of National Importance (INI) have been distinguished from that of the rest of the university sector. However in the figures for R&D expenditure considered above, higher education has also included the INI. Thus considering the very low share of R&D expenditure of the entire higher education sector, including the INI, the fact that they contribute close to 67% of all publications in 2001-02 is certainly something of an achievement. Undoubtedly the bulk of these publication, especially from the poorly funded university sector (in contrast to the INI) suffer from quality issues, notably publication in low impact journals and low citation rates[16], though the relative difference in the quality of publications from this and other sectors is not clear. The distribution of publications by institutions is also highly skewed overall, with 80% of publications coming from the top 10% of institutions involved.

Distribution of Publications Output by Sector

	Total Output			% Share of Output			% Growth
	85-86	94-95	01-02	85-86	94-95	01-02	85 to 02
Univ. & Colleges	12095	12324	16403	52.24	45.50	46.68	35.62
INI	3990	4978	7175	17.23	18.38	20.42	79.82
R&D	6569	9218	13329	28.37	34.03	37.93	102.91
Industry	411	496	708	1.78	1.83	2.01	72.26
Others	235	562	1237	1.01	2.07	3.52	426.38
Total	23153	27088	35142	100.00	100.00	100.00	51.78

It is notable that research publications from India sufferred a long period of decline, starting from 1980, according to the data of the SCI (Science Citation Index). Reaching a low in 1993, they

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10 + 2 onwards" , available on the website of the Principal Scientific Advisor to the Govt. of India at http://psa.gov.in and related background papers available there. Peculiarly though much of the report is devoted to solving the human resources constraint by improving science education rather than consider deeper socio-economic constraints that are widely acknowledged, albeit informally, in the scientific community.

15 M. S. Gupta and S. M. Dhawan, ``A Scientometric analysis of S&T publications output by India during 1985-2002, DESIDOC, Journal of Library & Information Technology, Vol. 28, No.2, pp. 73-85, 2008.

16 Gupta and Dhawan, op. cit.

reached back to 1980 levels only in 2003. In the period 1980-2000 while publications first declined and still did not reach 1980 levels after two decades, countries such as China, S. Korea and Brazil significantly improved their position. Chinese output in publications rose by a factor of 23, partly of course as a consequence of starting with a low base. South Korea began the same period with an insignificant 175 publications to virtually level with India by 2000. Brazil also registered steady growth during this period.[17] It is not clear what the causal factors were for this decline and subsequent recovery of Indian research publications, though from the bulk share contributed by universities to publications, one may suspect a close connection to the state of research in Indian universities. The issue merits further investigation.

In terms of patents though the university sector had a meagre share.[18] The bulk of the patents were filed by industry and research organizations while universities accounted for only roughly 3.5% of these patents. It is worth noting though that 55% of the patents granted in the Indian Patent office to Indian organizations were in the drugs and pharmaceuticals and chemicals sector, signalling the highly sectoral nature of innovation in India.[19] It is notable that these areas also have a significant presence in the subject-wise publication profile of Indian research. Together with agriculture, chemistry, basic life sciences and biomedical sciences, we account for more than 50% of all scientific publications in 2001-02.[20] Without further detailed studies the extent and nature of university-industry linkages in these sectors cannot be clarified. Thus the meagre share of patenting by the University sector may, to propose an alternate hypothesis, have substantially more to do with the perception of university research as the provider of scientific knowledge as a public good rather than the absence of strong linkages with productive activity. At the same time, the low level of patenting (and copyrights) in the Indian software industry, together with the fact that computer science and mathematics make for a small share (approx. 5% in 2001- 02) suggests, in the same vein, that the low level of research in this area has some correlation with the low innovation levels in India's IT sector. As in the case of some European countries discussed earlier, a closer examination of the citation patterns of Indian patents in the best performing sectors, may provide a better estimate of the university-industry linkage in these sectors. Unfortunately this author is not aware of such detailed studies, pointing to the sources of scientific knowledge for high-performing Indian patent sectors.

We may continue further and suggest that to understand university-industry interaction in Indian research and innovation, publications and patents as the sole indicators may have substantial limitations. A case in point is offerred by agriculture. Undoubtedly, since the initiation of the Green Revolution era, substantial innovation has taken place in the agriculture and horticulture sector (particularly in terms of adaptive innovation) in which the agricultural universities and research institutions have both played a role. However patent data or publication data evaluated in terms of citations or impact factors would hardly capture the role of various institutions in agricultural research and innovation.[21]

No discussion of university research would be complete without a discussion of the many negative features typically associated with the functioning of the university system.

Given the extremely bureaucratic nature of unversity administration, it is clear that research in the

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17 For a more detailed overview of the decline and subsequent recovery of Indian research publications, including some data issues, see T. Jayaraman, ``Science, Technology and Innovation Policy under Economic Reform: A Survey", 2009, available on the net at http://www.networkideas.org.

18 S. Bhattacharya, Current Science (2004), Vol. 92, No.10, p. 1336.

19 S. Mani, ``Financing of industrial innovations in India: How effective are tax incentives for R&D" CDS Working Paper Series, No. 405. 2008.

20 Gupta and Dhawan, op. cit.

21 A typical example of this is the Human Development Report 2002, that ranked India low in terms of technology development, even while ignoring precisely the aspects that we have mentioned.

university system remains a difficult undertaking. The origins of the poor quality of university faculty and low levels of academic achievement are highly contested issues, though it is difficult to establish with any reliability what are the real causes of this phenomenon. [22] Nor is it clear that the perceptions regarding the scale and scope of these shortcomings have empirical justification beyond the anecdotal. As we have noted earlier, the performance of the university sector in terms of publications despite the difficulties, suggests that, at the very least, there are several pockets of good performance that point to what may be done to improve the situation.

University finances are another problematic issue. While university expansion is typically funded by the Center through the University Grants Commission, the current difficult condition of State finances, makes it difficult for States to even absorb the funding on offer from the State government. Clearly a massive expansion of funding in higher education, as indeed in education as a whole is a necessity. The bulk of research funding for universities originates from Central funds. But the constraints of routine functioning of the universities imposed by the difficulties originating with State finances comes in the way of efficient utilisation of research funding.

It is one of the stranger features of current STI policymaking in India, that while on the one hand much is made of India's status as a would-be knowledge superpower, little attention is paid to the structural issues of Indian higher education in developing this theme. On the other hand, there is a significant amount of critical writing on the theme of university education, that however rarely, with some notable exceptions, as for instance the work of Basant and Mukhopadhyaya's [23], points to the current state of higher education as a significant obstacle to the realisation of the aspiration of making India a knowledge superpower. However even this study, while it elaborates the broad features of the crisis facing Indian universities has not significantly advanced a better understanding of the causal factors, in a sociological sense, that lead to this crisis.

Most significantly, higher education has for long been a site of contestation for social groups that are conscious of the need for access to higher education as part of a process of social mobility. The debate on reservations in higher education is only one example of this process. Apart from reservation, the drive to secure positions in the university system, whether as part of the faculty, or as a significant fraction of the student body or as key members of a powerful university bureaucracy, appear as other manifestations of this process. While much has been written in the popular media regarding the interference of `politicians' in university administration, it is clear that at least in part such interference originate in this aspect of the university in India.

The general nature of the crisis in Indian higher education in several respects, merits a deeper sociological understanding precisely because of its generalized and widespread nature. Issues such as the working conditions of scientists and engineers in the university system and their perceptions of what are the key issues, or the management of even leading scientific institutions have not received much attention in the literature. When problems such as the quality of instruction and the ability to attract faculty of high quality who continue to be productive are considered, the discussions and prescriptions fall into familiar patterns with little backing from detailed survey data relevant to these issues.

The final report of the National Knowledge Commission[24] is one of the few official bodies in recent

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22 For a representative critique of such matters in relation to the proposed expansion in higher education, see for instance Philip G. Altbach and N. Jayaram, ``India: Effort to Join 21st century higher education", University World News, 12 January 2009, available on the web at http://www.universityworldnews.com.

23 Rakesh Basant and Partha Mukhopadhyaya, `` An arrested virtuous circle? Higher education and high-tech industry in India", Paper presented at the Annual Bank Conference on Development Economics, Cape Town, June 9-11, 2008.

24 Available on the web at http://knowledgecommission.gov.in

times to have attempted a comprehensive overview of the education system so that it would be geared to the demands of the era of the knowledge economy. Unfortunately the report is significantly exhortative and prescriptive in nature, with little explanation of the logic of arriving at its prescriptions.

The Proposal for a Bayh-Dole type Act in India:

The proposal for an act governing the patenting of government funded research in universities and publicly funded research institutions appears to have come primarily from the National Knowledge Commission. Indeed the Commission claims the introduction of such an act in Parliament for its consideration as one of its achievements in its final report[25]. It is notable that the specific section of the final report recommending such an act provides an uncritical, celebratory review of the success of the Bayh-Dole act in the United States, ignoring the many critical differences between India and the United States in university research.

In the light of the considerations of the previous sections, it is clear that one may validly raise several issues relating to the relevance of the proposed bill. Much of what follows in this section applies mainly to the bulk of the higher education system, that is outside the set defined by the INI. We shall comment on the INI again at the end of this section.

The scientific productivity of the university sector despite its many weaknesses, appears to point to the enduring force of the idea of the university as the site of production of scientific knowledge as a public good. It is worth recalling that the primary motivating drive for the expansion of basic science in India has been drawn from ideals of self-reliance and national achievement. While the development of science and technology in India can be interpreted as knowledge-capacity building for an import-substituting path to industrialization in a more strictly economic reading, it is clear that this would be insufficient to understand the motivations that have hitherto determined the willingness to undertake and excel in basic scientific research in India. Reorienting this basic motivating factor by bureaucratic force, exhortations to raise the direct economic benefits of research and appeals to material incentives are not always likely to work even in the short term.

One may recall that in recent times this was the basic technique adopted by the CSIR leadership in its attempt to reorient the work of the CSIR. However current patent data[26] suggests that the CSIR patenting effort is losing steam and that the earlier spurt was more due to the available stock of patentable research rather than an increase in flow.

Secondly, as we have suggested in the previous section, much more substantial work needs to be done to understand the precise nature of university-industry linkages in India. Especially post-economic reform, the tendency has been to play up the disincentivising factors for industry in the pre-reform era and the weaknesses of the university sector. Few studies keep in view the possibility that the weak nature of university-industry linkages owes as much to the insufficiency of the enterprenurial outlook of industry and its inability to absorb scientific knowledge that is readily available indigenously. Or even more pertinently, that the behaviour of university as well as industry in relating knowledge production to industrial activity were due to very related causes.

This is not to argue that the university-industry linkages in the current situation are in any way

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25 See website of the National Knowledge Commission, op. cit.

26 S. Mani, to appear in Economic and Political Weekly. I am grateful to the author for intimating his results prior to publication.

optimal. However strengthening such linkages appear to call for a broader vision of what such linkages are to mean in the Indian context and how they are to be developed. It is clear in the U.S. context that the Bayh-Dole act built on a long-standing tradition of such linkages. In their absence, leapfrogging into such an era in India appears to be a strategy without substantial foundation.

Currently, it must be emphasized, there is no particular bar that stands in the way of patenting the products of university reseach or the work of other publicly-funded research. The Ministry of Science and Technology in 2006 had clarified that research funded by them could be patented by the concerned institutions.[27] Thus the proposed act appears even less a priority and in fact a distraction from more pressing concerns that we have outlined.

Thirdly, it is clear from the foregoing account of the general financial crisis of Indian universities that there are likely to be immediate gains from research productivity with the infusion of greater funds, provision of flexibility in their use and the provision of supporting funds for infrastructure. The argument that this would lead to unproductive expenditure in terms of research output needs to be weighed against the fact that the agencies that primarily fund university research like the Dept. of Science and Technology, have progressively established stronger peer review systems. It is arguable that some of the other science oriented departments have indeed much weaker systems of evaluation, especially in terms of external peer review, despite the levels of expenditure being significantly higher. If a Bayh-Dole type act is fairly insignificant in its contribution to research funding in the United States, it is unlikely to be of any significance here, and patent licensing earnings would do little to improve the difficult state of university finances.

Fourthly, the mechanisms proposed for ensuring that research with government funds are properly scrutinised for patentability and the responsibility of universities for ensuring that such research products are suitably licensed for commercial exploitation are most likely to add an extra layer of bureaucracy to a university system that already suffers from a surfeit of rules, regulations and procedures. The intellectual property committee proposed to be set up in every institution in receipt of public funds has so many duties that every research and teaching institution, such as the average Indian university, will be required to set up a sizable establishment to undertake the activities of this committee. Few institutions in India have the resources to make such a committee function meaningfully. Nor does the bill envisage any mechanism for the government to support and assist such IPR committees, through the provision of funds.

The setting up of Technology Transfer Offices even in the United states was an extended process. Setting up such offices across every university in India is unlikely to be an easy affair. It is of course true that such offices have already been set up in some institutions. However what is sought to be added through this bill is the requirement that such offices need to have patenting as a prime focus of their work. The larger question of course is one of defining the mandate of such Technology Transfer Offices, a subject that we will turn to in the subsequent section.

The additional requirement in the proposed act that the failure to patent suitable research would attract penalties, including financial ones, is likely to add further to bureaucratic procedure. The bill prescribes stiff penalties (in clauses 20, 21, 22) for the non-performance of the prescribed IPR duties by researchers and their institutions. Clause 19 provides little protection against the threat of penalties except in vague generalities. The threat of such penalties, together with provisions for the duties of the proposed committee, is also likely to delay considerably the publication of research. The managers of Indian publicly-funded institutions are notorious for adhering to the letter of regulations even while ignoring much of their spirit. This act is likely to be no exception and such penalty clauses typically attract bureaucratic excesses.

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27 Graff, op. cit.

Such clauses could also deter researchers, where outside of a few pockets of excellence, building a culture of inquiry and creativity that is willing to undertake the intellectual and other risks[28] remains a major issue. The low citation levels of Indian publication are arguably, in part, a consequence of opting for safe research, a tendency likely to be enhanced by the onerous mechanisms proposed under the Act.

It is not clear from the provisions of the bill, who or which body has the final say in whether a particular result from government-funded research constitutes intellectual property with commercial potential or not. This is a source of conflict, delays and confusion. It is also clear that the bill proceeds on the assumption that it will be easy to identify all intellectual property with commercial potential arising out of all research. As the record of the Bayh-Dole act in the United States shows, identifying the commercial potential of intellectual property accurately is at best a very dubious proposition, and in many cases striking innovations have not yielded significant licensing revenue. Nor does the bill have any provision for the resolution in a negotiated manner of any disputes that may arise between the researcher, the institution and the government.

Some of the considerations above clearly do not apply to the INI, given their increasing freedom from bureaucratic control (particularly from outside the institution), their good financial status and their ability to attract the attention of industry to some extent for the products of their research. However we may add here that the possibility of using the expertise of the INI to strengthen research in the university system at large could be set back if the attention of the INI turns centrally to the generation of intellectual property. It is of course unexceptionable if the generation of intellectual property is a co-benefit from a directed program of research that has certain clear national and social goals. However the very logic within which the proposed act has been proposed undervalues the importance of a STI agenda that is set by such goals.

Patent Markets in the post-TRIPS scenario:

Knowledge production in a developing country can be characterised as having three primary imperatives. First, technological catch-up in its various dimensions, including both the ability to learn from the exposure to advanced technical know-how produced elsewhere as well as the ability to generate new knowledge that can be eventually transferred to production, requires a national knowledge and innovation base. Both the literature on the developmental state as well as the spillover literature have emphasised this aspect. Second, the thrust of knowledge production, in terms of its sectoral emphases and areas of significant investment, needs to be oriented towards the eradication of the country's development deficits, insofar as such eradication requires scientific and technological inputs.

Both these imperatives have remained, at least in rhetorical terms, the goal of national policy in India. However, the manner in which these goals are to be realised has undergone a significant shift since the early 90s. The case can be made that the deficiencies in India's scientific and technological knowledge production effort notable in the pre-reform era were not significantly eradicated in the 90s. More recently, there has been greater awareness of the first imperative, though its translation into practice is perhaps yet to show significant results. The general laggard state of manufacturing in India, even in the era of relatively high growth, points to this.[29]

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28 Publication pressures are now increasingly part of the career researchers in India. While this undoubtedly is a necessary and welcome development, it is equally true that without adequate and sensitive evaluation mechanisms such pressures can act as a disincentive to risk-taking in intellectual activity.

29 For a clear and unambiguous statement on this aspect, see for instance, Report of the Prime Minister's Group on Measures for Ensuring Sustained Growth of the Indian Manufacturing Sector, National Manufacturing

With regard to the second imperative, considerable unease has been expressed by civil society organisations and political parties whether the nature of growth post-90s has in fact helped the channeling of science and technology efforts towards poverty alleviation and more inclusive growth.

The new element that has been added in the 90s and subsequently has been the increased effort that is required to ensure that knowledge-rents generated from public funding for research and innovation in a developing country are retained in the domestic economy. More generally, the third imperative for a developing country is to ensure that the maximum surplus from knowledge production through public investment is retained domestically. This question has always been a problematic one. The much-discussed `brain drain' has been one significant manifestation. In fact, this kind of implicit subsidy expressed by high-skilled emigration, often trained in institutions that are generously funded by government funds, from India to the developed world continues unabated.[30] While remittances from these emigrants may be construed as a kind of return on investment, the loss in terms of lost skills and corresponding developmental capabilities must certainly be much more.

In general in a liberalised, open economy there is no definitive means of ensuring that all surpluses from public investment in knowledge production remain within the domestic economy. In an earlier era, tariff barriers and a strong regulatory framework ensured that there were substantial benefits from new knowledge, even with low levels of intellectual property rights. Paradoxically, a stronger intellectual property rights regime in an open economy does the opposite, increasing the likelihood, especially in a developing country, of a host of new problems. While some firms may gain, there are substantial losses likely through the entry of much stronger MNCs. Even more significantly, especially in relation to the second imperative of S&T for development, the redirection of knowledge production to serve external markets is likely. The latter phenomenon would of course be very different from an earlier era , when a particular sector produced for an export market, though within a system of strong regulation and tariff and other protective barriers.

Intellectual property markets are inherently problematic because of the fact that they internalize not negative externalities but the positive externalities inherent in the production of scientific knowledge as a public good.[31] In developed countries such markets have emerged after a long history of knowledge production with close links to industry and the development of well-integrated national systems of innovation. In India the development of intellectual property markets in the background of weak research-industry linkages is likely to create a sector of the knowledge economy that will be closely akin to the relationship between primary commodity producers and First World markets. Intellectual property markets are not particularly marked by transparency and finding the right price of intellectual property is an issue.[32] In studies of patent licensing in Europe and Japan, it is clear that the key barrier to licensing out markets is the absence of information to find suitable partners[33]. In the developing country context the information question is likely to encompass the absence of knowledge regarding the true commercial potential of a patent both now

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Competitiveness Council, 2009. Available on the web at http://nmcc.nic.in/pdf/PMGR.pdf. Obviously the recommendations of the NMCC with regard to IPR issues are at variance with this author's observations.

30 S. Mani, CDS Working Paper, No. 382, 2009.

31 For an elegant discussion of this fundamental aspect of intellectual property markets see, Mark A. Lemley, Property, Intellectual property and Free Riding, Working paper No. 291, Stanford Law School, 2004.

32 Ironically, the point about the need for increasing transparency in patent deals to enable the emergence of well-functioning patent markets is made by the founder of Intellectual Ventures (a well-known ``patent troll''), Nathan Myhrvold, in Mark Lemley and Nathan Myhrvold, How to Make a Patent Market, Stanford Law School Working Paper no. 347, August, 2007. But as bloggers noted during Myhrvold's visit to India, such transparency has hardly come to pass.

33 These are from the results of an OECD study, reported in Dominique Guellec and Pluvia Zuniga, ``Survey on Patent Licensing, Results from Europe and Japan."

and in the future. Individual patents are less useful than patent clusters but it is unlikely that a knowledge industry that is not closely linked to industrial production at close proximity will be able to decipher the direction in which to extend individual patents to such clusters.

Within this general framework, intellectual property markets in a developing country such as India, that has significant knowledge capabilities in some sectors that are not always matched by corresponding capabilities in production, presents substantial difficulties. Intellectual property markets where institutions that are exclusively focused on research are free to sell their products without any restrictions would result in the transfer of knowledge with no benefits accruing to domestic industry. The proposed act, as well as current patent rules and regulations, do not ensure that intellectual property is licensed exclusively for production in India. There is no insistence that the licensing should be non-exclusionary. Nor is there any particular bar on outright sale of intellectual property, a route that may be preferred by institutions that do not have the capabilities for effective patent management.

It is indeed surprising from the policy perspective that an INI like the Indian Institute of Technology, Bombay (IITB) has signed an exclusive deal with Intellectual Ventures, a well-known patent trader, to manage its entire patent portfolio, without a clear indication of whether such a drastic change of policy has been adequately thought through for its serious implications[34]. Intellectual Ventures, to put it charitably, may be likened to the former high-flying energy trader, Enron, in that it trades in and licenses intellectual property without actual production of knowledge. Whether the urgency of the need to earn revenue on IITB's patent stock overrides the potential future benefit to the domestic economy from such patents appears not to have been a major point for consideration.

In the developing country context intellectual property itself and intellectual property markets are likely to hamper the realisation of the first two imperatives that we had pointed out earlier. It has already been widely noted in the case of health, that the international IPR regime has created serious problems in ensuring the production of drugs and treatments that are essential for Third World nations. Given the extensive literature on this subject we will not enter into further details on these questions.

However given the reality of the dominance of IPR in the world today, what pro-active strategy can developing countries adopt to circumvent the restrictions that currently hem them in? While a large-scale revolt against intellectual property rights is not on the horizon of global politicas today, it is nevertheless useful what room for manouevre exists for Third World governments that do not wish to treat the post-TRIPS scenario that we see today as an immutable reality. At the very least Third World governments with a considerable stake in accelerating human development may seek a route to circumvent the stringent restrictions of the current global IPR regime[35].

At the same time, it is important to underline that given the reality of the increased penetration of IPR in many areas of even basic science and almost all sectors of technology, it will be difficult to eventually ignore the need for adequate protection of knowledge in the public domain to prevent its being appropriated by private entities. In an era of the appropriation of traditional knowledge by firms and entities that seek to patent such knowledge, no country can treat traditional or scientific

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34 In this context it is strange that the faculty of IITB should seek to have their cake and eat it too. Having allowed the handing over of IITB's patent portfolio virtually without any opposition or criticism, they have now sought special emoluments on account of their INI status. However national importance is hardly a viable argument, when the products of their work are sought to be marketed to the highest bidder without any qualification of national interest.

35 Another arena where IPR issues will play a major role is climate change negotiations. Third World countries have a vital interest in open access to green technologies and significant differences have opened up between the G-8 and the developing countries on the question of technology transfer.

knowledge as a public good, unproblematically as was the case thirty or forty years ago especially in critical sectors. Clearly the way forward lies in expanding the scope and complexity of open source style patenting carried over from the original open source software models[36]. We will not enter into a detailed discussion here of these issues and reserve them for consideration on a future occassion. However in the short term India has much more to gain from maintaining a weaker IPR regime than a stronger one. The case is no different for the products of research from public funds.

Technology Catch-Up and Development Strategies:

The issue of the proposed act that we have discussed in specific detail here raises broader issues related to technology catch-up and development in the early 21st century. Typically in an earlier era, developmental states have had greater freedom and flexibility to frame their industrial and innovation policies. Whether economies were driven by export-led growth or by import-substitution, an earlier era presented considerable flexibility in terms of policy choices. It is also a truism that there was greater diversity in the growth trajectories of different developmental states and the manner in which they were politically and theoretically conceptualised.

There is little to suggest that such a diversity of strategies is no longer relevant, in a general sense, in the 21st century. What has changed however is that the policy space and the corresponding perceptions have considerably shrunk in the meantime.

The case of intellectual property rights offers a particularly telling example of this shrinking of the room for manoeuvre for developing countries. While Japan, S. Korea and the other emerging economies had considerably more freedom from intellectual property right restrictions that assisted knowledge spillovers from both exports and FDI, such freedom is no longer available to later comers. Even China, that embarked on a course of concerted deepening of its technological capabilities two decades ago, did so in an era of fewer controls. Today, intellectual property rights have been criticised as a prime negative effect particularly for innovations in critical sectors such as health, biotechnology and agriculture that are relevant to developing countries. The patent regime in health and drugs and pharmaceuticals for instance has drawn the criticism of even commentators from developed countries.

In the particular case of India, one may characterise its development trajectory in the pre-reform era as at best a developmental state on one leg, or perhaps more accurately a failed developmental state. Subsequent to the initiation of economic reform, the policy mind-set in India has tended to disregard India's all-round development deficit, ranging across all sectors from human development to manufacturing and innovation. Instead, policymaking has tended to uncritically borrow economic and policy nostrums that have little or marginal relevance, based on superficial similarities, ignoring fundamental structural differences. It has tended to view the experience of other states through the most rose-tinted descriptions offerred by policymakers elsewhere, ignoring not only home-grown considerations but also a considerable critical literature that emerges in the advanced industrial states themselves.

Nowhere has this been more manifest than in the arena of intellectual property rights and innovation. We have presented some arguments in the previous sections that this has been a feature of innovation policy in the post-reform era, an argument developed in more detail elsewhere.[37] The most obvious lesson from the experience of developmental states throughout the 20th century is that the benefits of interaction with the rest of the world in technological matters is beneficial only under the circumstance of building up of indigenous strengths in science, technology and innovation. Such

36 See for instance, Krishna Ravi Srinivas, ``TRIPS, Access to medicines and Developing Nations, " IIM Bangalore Working Paper No. 248, Nov. 2006 and references therein. Another detailed discussion can be found in

37 T. Jayaraman, op. cit.

strengths cannot be built up without the cognizance of the need to protect this effort, until a suitable period of gestation has passed. In contrast in India, innovation policy in the last two decades ignores such considerations, despite the efforts of many sections particularly in the scientific community but more generally in civil society to draw attention to these issues.

The act that we have critically viewed here is not the only important issue from the viewpoint of developing innovation in India. But it offers many lessons on the current nature of policymaking in innovation in this country and the many problems in this regard.