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Viability of Bayh-Dole Act of USA in Context of India: Critical Evidence from Review of Literature

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Abstract
The Bayh-Dole Act (BDA) (1980) of USA changed patent policy, involvement of universities in patenting, augmented commercial revenues and increased collaborations of universities with industries. Therefore, the Act became boon for universities-industries relation and private players in USA. The Government of India (GoI) desired to adopt BDA type Act known as Protection and Utilization of Public Funded Intellectual Property Bill (PUPFIPB)-2008 in Indian research academia. It would help to increase protection and utilization of IPRs originating from public-funded research and commercialization of invention, generation of revenues for research institutions/universities. However, there are debates about this bill in Indian research academia whether the GoI should adopt this bill or not. The Indian public-funded research institution's situation and socio-economic structure of common citizens are different as compared to USA. Therefore, the present study assesses the viability of USA's BDA in Indian context. The study achieved following objectives: To identify the usefulness of BDA in USA, its viability in India; thereupon this provides comparison of factors related to science and technology, IPRs in USA and India; to bring out conclusive policy suggestions to increase the awareness of IPRs. Thus, it provides policy implications to increase the effectiveness of Indian bill in research academia.

Keywords: BDA; Research academia; R&D; IPRs; USA; India; PUPFIPB.

1. Background

Research and development (R&D) is a significant activity of public research organizations and universities. Existing researchers/scientists are diffusing their scientific ideas/knowledge/output/technology through journal publications, research paper presentation in conference, seminar, workshop and symposium across economies (Brown, 2009). Industrial R&D in various manufacturing sector get also significantly influenced due to R&D in public-funded research institutions (Mowery and Shane, 2002; Yueh, 2007; Rath et al., 2014). Researchers and scientists are getting security of their research output by intellectual property rights (IPRs) policies. There is significant association among the researchers/scientists, research organizations/universities, science & technology and innovation, R&D, IPRs, technology transfer, commercialization, licensing, startups/industries, manufacturing growth, product development, new market, employment opportunities, economic growth and development. Therefore, in past few decades, universities have implemented policies to create new startups and venture (Stephen, 2010; Miner et al., 2012).

United States of America (USA) is a pioneer country in the world, which gave important attention to protect IPRs of federally-funded research academia (Sengupta and Ray, 2015). In 1980, USA adopted Bayh-Dole Act (BDA) to create uniform patent policy, involvement of universities in patenting, commercialization, licensing, technology transfer and university-industry-relation for federally-funded research institutions (Reczek, 2004; Ray and Saha, 2010). Universities and research organizations have established their own internal technology transfer offices (TTOs) to manage licensure of universities patents.

Government of India (GoI) also desired to adopt BDA type Act that was known as Protection and Utilization of Public Funded Intellectual Property Bill (PUPFIPB)-2008. The Bill will provide compulsorily protection of intellectual property (IP) originating from public-funded research institutions (i.e., Universities, CSIR, ICMR, ICAR and others. It would increase commercialization of invention and generation of revenues for public-funded research institutions. However, there are debates on this Bill in Indian research academia whether India should adopt this Bill or not. Few researchers criticized that the Act would be harmful for Indian public. Indian public-funded research institution's situation is not similar to USA in 1980 (Satyanarayana, 2008), therefore the present form of the Bill can bring negative consequences in Indian R&D sector.

1.1. Research Questions and Objectives of the Study

The present study intends to answer on following research questions:

- What is role of science and technology, IPRs in India and USA?
- How IPRs do increase patenting, licensing, commercialization and technology transfer?
- How IPRs are useful to increase economic growth and development?
- Why Government of USA has adopted BDA in federally-funded research organizations?
- What is Protection and Utilization of Public Funded Intellectual Property Bill (PUPFIPB)-2008?
- How BDA of USA and PUPFIPB-2008 of India are similar?
- Why GoI had desired to pursue BDA type Act in public-funded research academia?
- What would be the viability of BDA type Act in India?
- What could be negative consequences of BDA and how Indian policy makers can reduce the negative implication of this Act in India?

The present study seeks to attain the following objectives:

- To assess the influence of BDA on patenting, commercialization, licensing, technology transfer, university-industry relation and self-reliance of university on federally research fund in USA
- To investigate the viability of BDA type Act in Indian context
- To explore the comparison of factors related to science and technology, and IPRs for USA and India
- To bring out conclusive policy suggestions to increase the awareness of IPRs in Indian research academia.

2. IPRs and Science & Technology and Innovation

2.1. IPRs and Its Components

Technological invention, patents, trademarks, geographical indicators, industrial design, layout design, plant variety, copyright, artistic and literary works are the various forms of IPRs. IPRs provide the owner of IP that legally enforceable power to prevent others from using it. Innovative idea converts in form of technology, and technology creates a new knowledge for product manufacture in industries and commercial field. Knowledge changes in inventions, utility model and design for industrial development (OECD, 2014). It helps entrepreneurs to recovers costs of their innovative expenses (Laik, 2015). In industrial countries, IPRs are part of institutional infrastructure that encourages private investments in formal R&D and creative activities (Yueh, 2007). USA, Brazil, China, South Korea, United Kingdom, Malaysia and Singapore are doing well in science and technology due to their strong IPRs. These economies have achieved high per capita income and human development.

2.2. Science & Technology and Innovation

Science & Technology (S&T) and Innovation has significant advantage to boost economic growth and human development by adopting advance production technology in the economy (OECD, 2000). Advance technology emerges with extensive involvement of a country in R&D. Science, Technology and Innovation (STI) are major driver to improve national competitiveness and maintain sustainable growth (OECD, 2000). Innovation is a scientific knowledge and technological know-how which can be used to develop new goods and create more employment opportunities. Innovation is major driver to increase productivity through technology-based manufacturing process, products that provide more value to customers (Satyanarayana, 2008; OECD, 2014). Thus, additional job opportunities for peoples to increase their contribution in economic development. Innovation and scientific knowledge would emerge through rigorous involvement of peoples in R&D (OECD, 2014).

2.3. Technology Transfer and Commercialization

Technology transfer is process in which available technology is transferred between two or more parties (Sharma and Saxena, 2012). It is a procedure in transferring scientific results, knowledge, technologies, ideas, methods of manufacturing, samples of manufacturing and facilities among the governments, institutions, firms and business organizations (Manral et al., 2012). Technology transfer ensures that scientific and technological development is accessible to wide range of users. These users can produce new products and application material or service using existing technology. However, technology transfer includes a formal and informal agreement between technology developers and seekers for commercialization of a technology (Manral et al., 2012). The process of technology transfer is based on mutual interest and agreement between two or more than two parties.

Technology companies, research institutions, universities, firms, business organizations and government organization may be parties for technology transfer. Industry-academia interaction is helpful to move new technologies from research lab to market place faster and efficiently (Kochupillai, 2010). Patenting activities are a classical tool to improve transfer and diffusion of technology (Sharma and Saxena, 2012). Therefore, patent determines the effectiveness and enhancement of technology transfer. Patenting increases technology transfer through licensing and contractual agreements between parties. A licensing agreement comprises well define clauses (e.g., royalty rate and exclusivity). If technology transfer to be transferred by protected patent then other party would be involved in defined licensing agreement. Otherwise, a transfer is located in a country that does have patent protection then parties may rely on contractual agreements. Without patenting such agreement, it may be a commercial risk, especially for transfer technology.

2.4. Public-Funded Research and Economic Development

It is R&D fund that is given by government to universities/research institutions to all fields of sciences like engineering, medicine, health science, scientific and social sciences for doing research. It creates innovation and generates goods or services for the society. There is positive relationship between public-funded research and innovation (OECD, 2014). Innovation and invention increase productivity of resource and wealth in an economy. Thus, technological development brings several alternatives to improve economic and social benefits.

2.5. Patent and Taxpayer

As every taxpayer pay taxes to the government and the government gives this fund to universities/research institutions for doing R&D. When a person does an invention and he/she can get patent, has a legal and inclusive right to sell this patent to industry. Patents help for industries to produce advance goods or services and sell in the market for public consumption. However, the process can create monopoly and price of product in domestic market. Thus consumer/taxpayer pays the double price for products.

3. Bayh-Dole Act of USA

Bayh-Dole Act (BDA)was introduced in USA in 1980, allowing universities to retain IPRs of research output from federally-funded research (Brown, 2009; Ray and Saha, 2010). The Act was proposed by Birch-Bayh and Bob-Dole, enacted by the United State Congress on December 12, 1980 and came into effect on July 01, 1981 (Sampat, 2009; Paraskevopoulou, 2013). BDA gave legal rights to universities, research academia, small business or non–profit institutions to protect and control of their inventions. BDA facilitate the movement of technology by providing legal ownership of the IP arising from taxpayer-funded research. There came significant change in patenting, commercialization, technology transfer, license and options agreements and licensing income after BDA in USA (Sampat, 2009; Brown, 2009; Thursby and Thursby, 2010).

BDA was exceedingly successful in transferring technology from research academia into commercial world. It provided exclusive license to other parties and encouraged university to develop “technology transfer offices” to manage their patentable inventions, thus it has increased TTOs in USA. Universities students and faculty took to establish their own technology firms, therefore investments by venture capital has also increased (Mowery and Shane, 2002). BDA has improved university-industry relation and commercial revenues to universities/research institutions (Reczek, 2004; Paraskevopoulou, 2013). It provided technical assistance in filing patent application and creating new startups (Brown, 2009), subsequently increase in financial support by private sector in new venture (Mowery and Shane, 2002). The Act provide incentive to pursue similar legislation to promote IPRs in developed and developing economies (Paraskevopoulou, 2013; Sampat, 2009; Stephen, 2010; Sengupta and Ray, 2015).

3.1. Need of BDA in USA

Before BDA, the federal government had accumulated around 28,000 patents of which only 5% had been licensed in USA (Satyanarayana, 2008; Brown, 2009). Many patents were unutilized to developed market related benefits (Vivekanandan, 2008)**.**Most TTOswere unable to generate adequate revenues from licensing of their patents to recover their operational cost. Output from federally-funded research was not moving efficiently from lab to market place (BayhDole25, 2006). By that time patenting process was complex and time consuming and there was a difficulty in defining and protecting the university's interest in the transactions (BayhDole25, 2006). Higher education system was significantly large with heterogeneous collection of institutions (religious, secular, public and privet). There was lacuna in national administrative control and encouraged considerable inter-institutional competition for student, recourse and prestige. That time USA was losing their competitiveness in R&D at global level (Brown, 2009).

3.2. Objectives of the BDA in USA

The prime aim of BDA was to create a uniform patent policy among public-funded research agencies (BayhDole25, 2006). It also provides awareness to university and research institutions towards IPRs (patents and commercialization) on federally-funded research in USA. BDA was intended to achieve following objectives in USA: (i) To provide self-reliance to the university/research institutions, (ii) To generate revenues based on federally-funded research, (iii) To increases commercialization of technology in industrial area, (iv) To increase transfer of technology, and (v) To build a bridge between universities/research institutions with industries.

3.3. Major Provisions of BDA in USA

The Act had following provisions: (i) Non-profit organization including universities and small businesses may elect to retain title of innovation developed under federally-funded research projects, (ii) Universities are encouraged to collaborate with commercial concern to promote the utilization of inventions arising from federal-fund, (iii) Universities are expected to file patents on inventions, (iv) Universities are liable to give licensing preference to small businesses, and (v) The government retains a non-exclusive license to practice the patent across world (Vivekanandan, 2008; Paraskevopoulou, 2013).

3.4. Impact of BDA on Patenting, Commercialization and Technology Transfer in USA

In the past quarter century, universities have undeniable become much more involved in technology transfer. Many leading universities had established technology transfer programs before adoption of BDA. A university funding for academics R&D has grown from 14% of the total in 1980, increased to 20%in year 2001 (BayhDole25, 2006). Over the same period, total funding for academics R&D from all sources has grown from around dollar 6 Billion to dollar 33 Billion in 2001 (BayhDole25, 2006). The Act also provided surplus opportunities to research organizations to maintain research quality due to extensive commercialization of technology (Stephen, 2010).

3.4.1. Patenting Situation

Before BDA, universities were reluctant to become directly involved in patenting and licensing activities precisely (Satyanarayana, 2008). Most universities did avoided patenting and licensing activities. Few universities have begun their participation in patenting and licensing with low growth before BDA. Universities think that such involvement would compromise their commitments to open science and their institutional missions to advance and disseminate of knowledge. "*Paradoxically, when patent right remained in the public domain and belonged to everyone, no one had the necessary economic incentive to undertake the risks of commercialization* (BayhDole25, 2006)." What sense does it make to spend billions of dollars each year on federally-funded research and prevention of new development from benefiting the American people due to dumb bureaucratic red tape (BayhDole25, 2006)?

One of the most important effects of BDA was to increase university's involvement in patenting and licensing. After adoption of

BDA, universities increasingly become directly involved in patenting and licensing. BDA fundamentally changed U.S. patent policy for federally-funded research which conducted by non-profit organization such as universities or by small or start-up businesses. The passage of BDA was characterized by a sharp increase in patenting and licensing activities in universities (Stephen, 2010; Mowery and Shane, 2002). The data in Table: 1 reveals that large increase in university patenting after 1980.

Table 1: Number of patents granted to 100 top universities in USA

Year	No. of Patents
1974	177
1979	196
1984	408
1989	1004
1994	1484

Source: Mowery and Ziedonis (2000).

3.4.2. Commercialization

USA was allowed only non–exclusive licensing of public-funded research to promote competition after 2nd world war. Non-exclusive licensing did not provide adequate incentive to private industry to come forward and pickup universities for commercialization (Satyanarayana, 2008). Therefore, these created competitiveness crisis of the 1970 in USA (Brown, 2009). Subsequently, USA had accumulated large unutilized patents based on federally-funded research. After BDA, the USA government allowed exclusive licensing of public-funded research at the discretion of the institutions (Ray and Saha, 2010). Therefore, BDA relied to promoting intellectual property protection for innovators relying on market forces guide and commercialization of innovation.

3.4.3. Technology Transfer Offices

USA had inconsistent policy in technology transfer for federally-funded research before BDA. This policy provides negligible returns on taxpayer's amounts (BayhDole25, 2006). Low level of innovation and little federally-funded or academics research output arise from laboratories to the market place due to absence of clear policy (BayhDole25, 2006). After adoption of BDA, the universities had set-up internal TTOs to manage licensure of universities patents. BDA increased new organizational structure within the universities through the establishment of more TTOs. The number of university's TTOs has increased from 25 in 1980 to 200 in 1990 and virtually all universities have established their own TTOs by the century (Ray and Saha, 2010).

4. BDA type Legislation in India

The GoI have taken several initiations to protect IP of individual researcher/scientist in public-funded research organizations. Indian government has defined all form of IP (trademark, patent, design, copyright, geographical indicator and plant variety) under various Acts (i.e., Copyright Act, 1957; Indian Patent Act, 1970; Design Act, 2000; Semiconductor Integrated Circuits Layout-Design Act, 2000; Protection of Plant Varieties and Farmer's Rights Act, 2001) (Nair and Nair 2009; Lin et al., 2010). However, Indian research academia/research organizations are unable to make better use of these legislations due to ineffective compensation system and unconscious of researchers towards IPRs.

4.1. Protection and Utilization of Public-Funded Intellectual Property Bill-2008

Similar to BDA, the GoI desired to adopt a bill which was known as Protection and Utilization of Public-Funded Intellectual Property Bill (PUPFIPB), 2008. This Bill seeks to encourage public-funded research organizations to patent their inventions and offer them to industry for commercialization on a revenue sharing basis (Janodia et al., 2009). The Bill proposes that R&D institutions would acquire intellectual property protection in any countries and generate revenues through commercialization of technology (Kochupillai, 2010). PUPFIPB is a new legislation being considered by parliament, which was introduced in 2008 winter session of the Rajya Sabha and proposed by the Ministry of Science and Technology. It is similar to BDA of USA and stimulates public-funded research for greater industrial application. It seeks to encourage disclosure of institution and uphold their right to license their patents, either exclusively or non-exclusively. It provides incentive to industries to come forward and pickup inventions from public–funded research institutions for commercialization (Ray and Shah, 2010).

4.2. DebatesonPUPFIPB-2008 in India

TheBill is an Indian version of USA's BDA and it seeks to improve creativity and innovation to enable India "*to compete globally and for the public good.*"It aims to protect all form of IP (i.e. copyright, patent, trademark, design etc.) arises through public-funded research institutions (Kochupillai, 2010). TheIPRs will be held by the grant recipient or by the government. This appears as a better way to increase technology transfer from research institutes to the industry (Kochupillai, 2010). The Bill will utilize the R&D output to increase economic growth and national competitiveness. It would provide the public-funded research institutions/universities more independency and autonomy from bureaucracy. It would shift the focus of researchers on emerging issues of industries which need immediate solution. BDA type Act in India has frightening effects on scholarly communication and promotes secrecy. Researchers and institutions would inform to the government before research publication as per the norm of this Bill. It would be attractive and proven solution to growing need for technology transfer policy. The Bill would increase patent and commercialization, maintain collaboration between industry and research institutions, government and public-funded research universities in India (Satyanarayana, 2008).

4.3. Purpose of the PUPFIPB in India

The main objective of this Act is to generate revenue and creation of public good with the help of two aspects (Kochupillai, 2010). First, it protects and utilizes IP by incentivizing creativity and innovation. Second, it promotes self-reliance through generating revenue from IP so that reduce dependency of universities/research organizations on public funding. Public funding is essential for research in basic science and public health. Both aspects of the Bill could be achieved then research organizations would shift their focus from basic science to more commercial and viable research. Thereby, universities/research organizations would become more self-reliance on research fund, thereby government would be in a position to avoid additional budgetary allocation for research field.

4.4.Requirementof BDA type Act in India

In India, a large number of patents in various sectors have been registered by research organizations/universities in national and international patent offices (Vivekanandan, 2008). It shows that Indian research academia/universities (e.g., IITs, IISc, TIFR, JNU, BARC etc.) and national laboratories have an effective position in science and technology at global level (Hyndman et al., 2005). Indian universities/institutions/research labs have produced notable and viable patents. GoI has given significant efforts to increase commercialization of technology (patents) (Rath et al., 2014). Despite that commercialization of technology did not get significant improvement in India (Vivekanandan, 2008). Indian research academia could not make an association with industries for commercialization of technology (Kochupillai, 2010). Low transfer of technology is identified as a critical issue for low commercialization of available technology. Unavailability of

TTOs in universities and research academia is another reason for low transfer of technology transfer across Indian firms. Industries are reluctant to buy technology from Indian research academia due to lack of patent literacy (Abhyankar, 2014). Indian researchers do not want to involve in IPRs related activities. Subsequently, there is low collaboration among government, research academia and industries in India. Large, medium and small enterprises have poor linkages in India (Abhyankar, 2014). Therefore, Indian manufacturing sector is unable to produce high quality products.

5. Comparison of Science and Technology and IPRs Related Factors in India and USA

5.1. Science and Technological (S&T) Indicators in India and USA

India has a lower position in science and technology than other emerging economies like China, South Korea, Thailand and Indonesia. India is investing less than 0.9% of its GDP on R&D in last 8 years (Refer to Figure: 1). In India, R&D investment per researcher is extremely lower than USA (Refer to Figure: 3). Simultaneously, researchers per million peoples are also very less in India than USA (Refer to Figure: 4). India also unable to increase gross expenditure on R&D similar to USA (Refer to Figure: 2).Therefore, India have an insignificant progress in S&T and technological innovation.

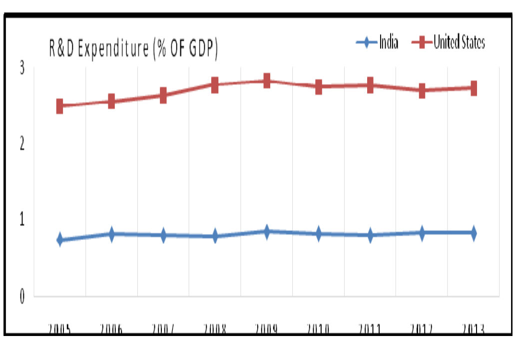

Figure 1: R&D expenditure (% of GDP) in India and USA

Source: The data for Figure 1-8 are derive from World Development Indicators (World Bank, 2016).

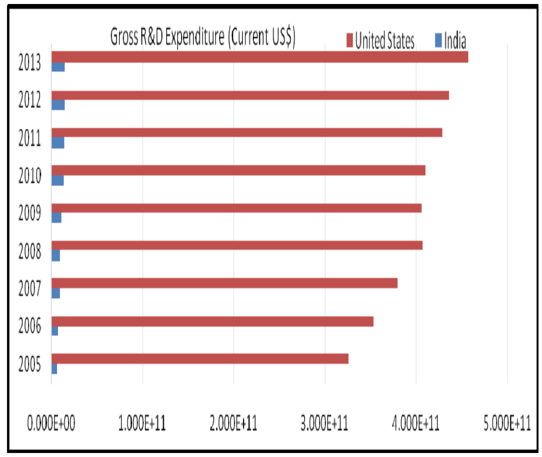

Figure 2: Gross R&D expenditure in USA and India

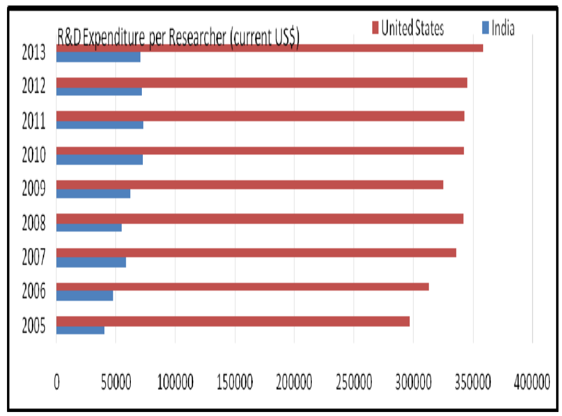

Figure 3: R&D expenditure per researcher in USA and India

Figure 4: Researchers in R&D (per million people) in USA and India

High-technology exports include aerospace, computers, pharmaceuticals, scientific instruments and electrical machinery related products. China, India, South Korea and Malaysia has increased share of High-technology exports as % of manufactured exports after 2011. However, India could not do the same to boost the share of High-technology exports in manufacturing exports (Refer to Figure: 5 and 6). Hence, India's progress in exporting of High-technology products is less pronounced (Wignaraja, 2013).

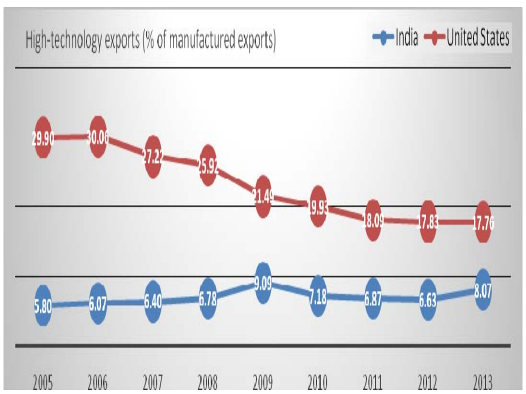

Figure 5: High-technology exports (% of manufactured exports) in India and USA

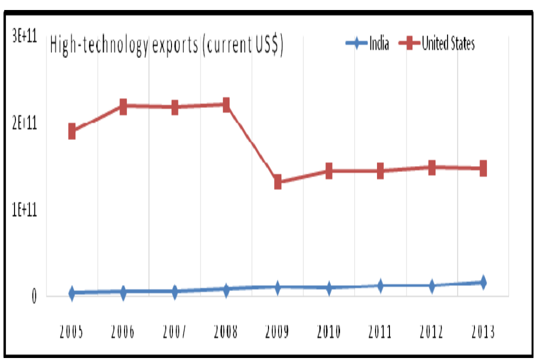

Figure 6: High-technology exports (Current US$) in USA and India

ICT goods exports and imports are crucial driver for diffusion of technology across regions/industries. It is an important source to create innovative goods and services to make people's life easier. USA did commendable progress in ICT sector especially in computer and medical technology (Refer to Figure: 7 and 8), while India could not get significant benefit from ICT sector to increase economic development.

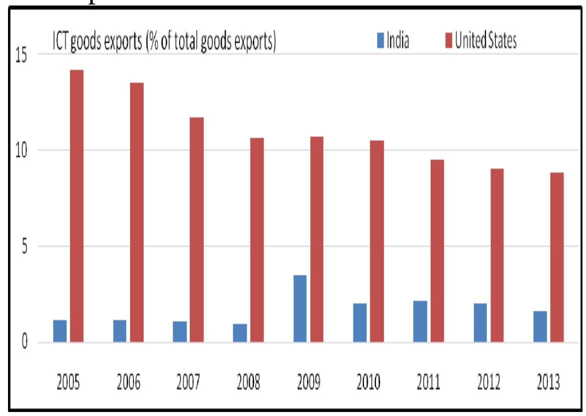

Figure 7: ICT goods exports (% of total goods exports) in USA and India

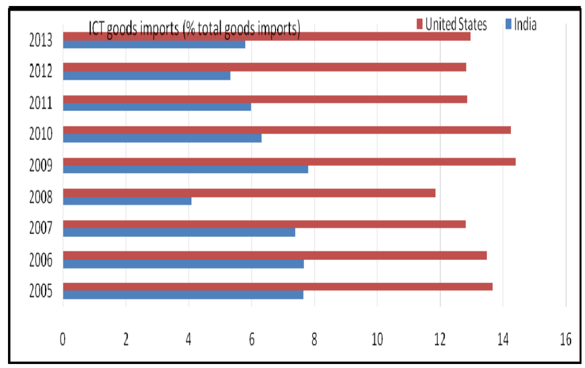

Figure 8: ICT goods imports (% total goods imports) in USA and India

5.2. Comparison of IPRs in India and USA

Patent is a best indicator of technology and main components of IPRs. India is so lagged behind in patents filing compared to USA. The number of patents files per 1000 Indian researchers is lower than USA (Refer to Figure: 9).

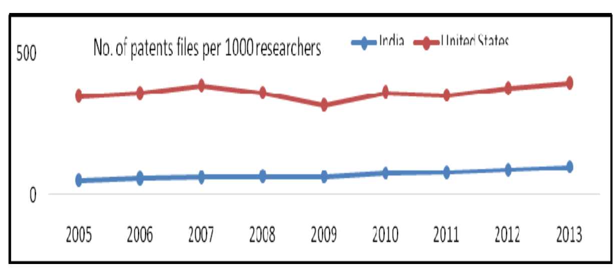

Figure 9: No. of patents files per 1000 researchers in USA and India

Source: http://www.wipo.int/ipstats/en/statistics/country_profile/.

Indian researchers are given priority to file patents in Pharmaceutical sector during 2000-14 (Refer to Figure: 10.1). Organic fine chemistry and computer technology sectors have a 2nd and 3rd position respectively in patenting in said period. While, researchers have more patents in Computer Technology and Medical Technology sectors during 2000-14 in USA (Refer to Figure: 10.2). Pharmaceutical sector have 3rd largest numbers of patents in USA.

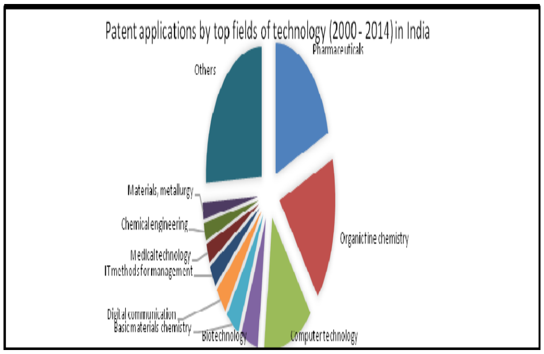

Figure 10.1: Patent applications by top fields of technology (2000 - 2014) in India

Source:
http://www.wipo.int/ipstats/en/statistics/country_profile/.

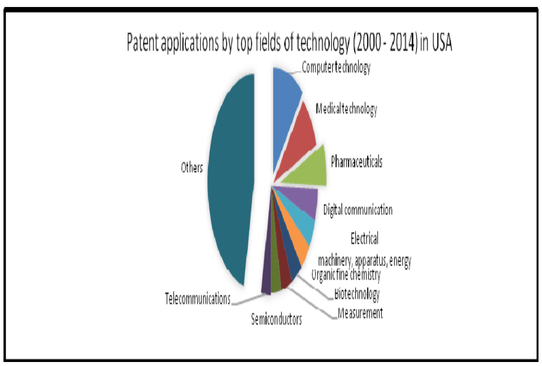

Figure 10.2: Patent applications by top fields of technology (2000 - 2014) in USA

Source:
http://www.wipo.int/ipstats/en/statistics/country_profile/.

The number of industrial design registered per 1000 researchersare relatively very lower in India than USA (Refer to Figure: 11).

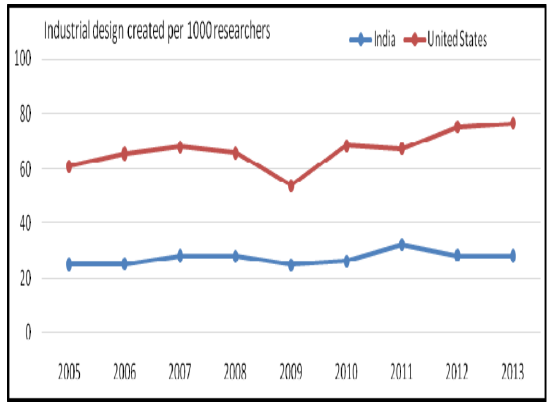

Figure 11: Industrial design fillings in India and USA

Source:
http://www.wipo.int/ipstats/en/statistics/country_profile/.

As India is a destination of large number of small industries and firms. Thus, the number of trademark registered per 1000 researchers in India is higher than USA (Refer to Figure: 12).

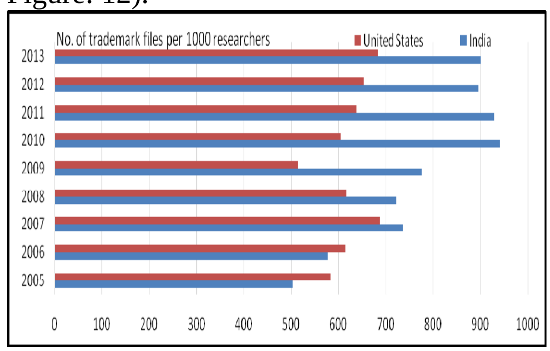

Figure 12: No. of trademark files per 1000 researchers in USA and India

Source:
http://www.wipo.int/ipstats/en/statistics/country_profile/.

USA tremendously increased investment on charge for use of intellectual property payments and receipts per researcher during 2005-2013. Therefore, USA has dominant position to produce high manufacturing goods in globally competitive economies like China, Malaysia, Singapore and South Korea. The GoI did not increase spending on charge for use of intellectual property payments and receipts per researcher in same time period (Refer to Figure: 13 and 14).Hence, R&D sector, science and technology are unable to create advance technology in India. GoI did not follow strong IPRs regime to protect IP of researchers and scientist, thus India has a lower position in intellectual property protection than USA (Refer to Figure: 15).

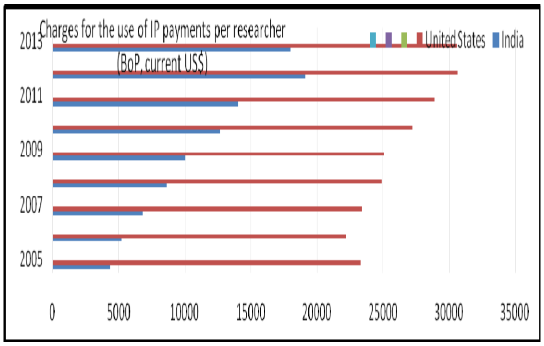

Figure 13: Charges for the use of IP payments per researchers (BoP, current US$) in USA and India

Source: World Development Indicators (World Bank, 2016).

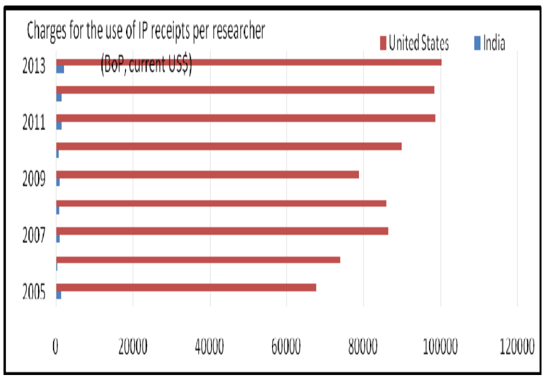

Figure 14: Charges for the use of IP receipts (BoP, current US$) in USA and India

Source: World Development Indicators (World Bank, 2016).

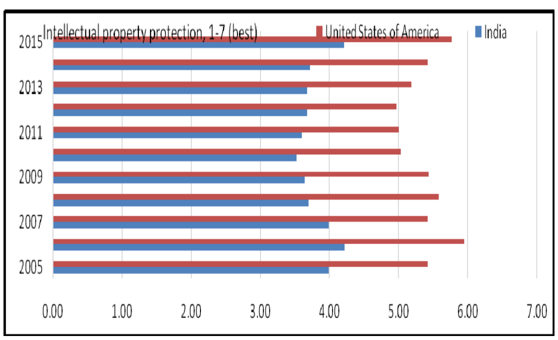

Figure 15: Intellectual property protection, 1-7 (best) in USA and India **Source:** World Economic Forum**.**

6. Expected Adverse Effect of PUPFIPB-2008 in India

(i) Indian bill will covers all form of IP: The Bill will covers all form of IP which includes trademark, patent, design, copyright, geographical indicators and plant variety. These all IP form has defined under various Acts in India. If it is being applied in current form then there is high possibilities that earlier Acts would be failed and India IP system would be more complex (Nair and Nair 2009; Lin et al., 2010). So, the definition of the Bill is ambiguous and creates more confusion (Janodia et al., 2009; Kochupillai, 2010).The Bill does not have a specific agenda to create effective innovation in India (Stephen, 2010).

(ii) Royalties provision will increase the consumer cost: Indian bill have many provisions which may have negative effect on human livelihood. In India public-fund for R&D comes from taxpayers. Public-funded research institutions/universities do research to create new technology and invention. New technology and innovation helps for industries to generate public goods. These public goods should be available for public at cheaper prices. While the Bill ensures that the IP creators (researchers) will be given a share of 30% of the income from the royalty to the government. Subsequently, researchers would give low focus on social obligations (Janodia et al., 2009). Royalty provision will increase the cost of products which was created by publicly-funded research. Taxpayers would pay double taxes for the products, while the main objective of public-funded research is to increase the social and economic growth. Hence, social community will not get desired benefit if the Bill is adopted in current form (Nair and Nair 2009).

(iii) Exclusive licensing will increase the cost of products in market: This Bill will give exclusive and non-exclusive licensing. Exclusive licensing will creates monopoly in the domestic market. Monopoly will set up the high price of the products for public. While, there is no mechanisms in the Act which can adjust the prices of products for consumers (Vivekanandan, 2008). Thus exclusive licensing would be weak point of this bill. Exclusive licensing to innovators will be worrisome for Indian population (Lin et al., 2010). For research institutions which receive the research grant would be compulsory establish intellectual property management committees to evaluate the commercial potential of output for public–funded research (Lin et al., 2010). This provision can reduce the involvement of researchers and research organizations/universities in R&D activities.

(iv) It will create short-term research: According to provision of the Act a researcher can sell their own patent to industries or business organizations. Therefore, patenting and licensing rights will go in the hand of private players which influence inventor to do more research. Private players and industrialist will promote researchers to sell their patents to them.Thus it will create short-term research and (Janodia et al., 2009). Private players will create costly goods with commercialized patents. These goods will be out of economic capability of common peoples and have a negative effect in the society. Therefore these goods cannot be considered as public goods. The Act will be arm of TTOs which give the exclusive licensing to those industries which have a good relation with TTOs. This process would provide the additional safeguard and monopoly to industries. Subsequently, it will deprive new startups or public entities from their legal rights and large portion of workers in manufacturing sector (Vivekanandan, 2008).

(v) It makes patenting mandatory in India: The Bill will make patenting mandatory in Indian research academia, which would increase legal activities for scientists/researchers. Every researcher/scientist has to inform to institute that IP generated by him in a specific time-period (Kochupillai, 2010). If researcher/scientist would be unable to do same then the government has a right to impose fine/penalties on researchers. Penalties provisions may decrease the research activities and attentions of researchers to maintain research quality (Janodia et al., 2009; Kochupillai, 2010). While BDA in USA does not make patenting mandatory and does not have penalties provision (Lin et al., 2010). The basic problem in mandatory patenting, commercialization and penalty provision in public-funded research institutions will distract scientists from their professional (Kochupillai, 2010). This would propel only such research in the universities that is relevant to the industries and have a commercialization potential.

(vi) ***Unnecessary documentary works for researchers/scientists:*** It is expected that scientist/researcher would be busy in legal procedure or paper works. This would be time consuming procedure for a researcher and IP committee. Thus, every researcher will be busy in paper (administrative) work to maintain this process. It would increase maintenance cost and requirement of additional staff for universities/research institutions.

(vii) How researcher or scientist will decide that what IP is? Another drawback of this bill is that every researcher/scientist is compulsorily required to inform the government for their IP within a specific time-period. However, "how a researcher/scientist will decide that what is IP?" As every researcher does the common thing daily so, the inventor will forward it to the Intellectual Property Committee of the institute. The committee will decides what is potential of this IP. Thereafter, the IP committee will forward it to government to take decision on whether to file IPR or not.

7. Conclusion and Guideline for Indian Policy Makers

The present study assesses the influence of Bayh-Dole Act (BDA) on patenting, commercialization, licensing, technology transfer, university-industry interaction and self-reliance of university for federally-funded research organizations in USA. Thereafter, it investigates the viability of

BDA in Indian context. Thereupon, it provides comparison of factors related to science and technology, IPRs in USA and India. Finally, it facilitates some conclusive policy suggestions to increase the awareness of IPRs in Indian research academia. The study concludes that BDA has increased the patenting, licensing, technology transfer and commercialization in USA (Mowery and Shane, 2002; Reczek, 2004; Stephen, 2010; Brown, 2009; Sampat, 2009; Ray and Saha, 2010; Thursby and Thursby, 2010). It has changed the USA patent policy, increased commercial revenue, and created new productsand market from federally-funded research (Stephen, 2010; Paraskevopoulou, 2013). Concisely, BDA brought great benefits for American economy and society. It nurtured three mechanisms: (i) promoting intellectual property protection for innovation, (ii) focusing on market force to guide commercialization of innovation, and (iii) maintaining a consistent level of support for higher education and scientific research (BayhDole25, 2006). Hence, it could be said that BDA became boon for universities and industries in USA.

In India, the BDA will be inappropriate in current socio-economic environment. As Indian public-funded research institutions/universities situation is not similar to USA, thus the present form of the Bill will be unsuccessful. The descriptive results of the study imply that India are spending low share of their GDP on R&D than USA. R&D expenditure per researcher is extensively very low in India than USA. In India, R&D expenditure is primarily bear by public sector, and around 67% and 29% R&D fund share by public and private sector respectively (Ministry of Science and Technology, GoI & Ministry of Commerce & Industry, GoI, 2011-12). Approximately, 4% R&D fund comes from high education sector. While, in USA, 70 to 80% of R&D fund contribute by private sector. India has around 136 researchers on per million peoples, while USA has around 4100 researchers on same population. India has lower position in high-technology exports and ICT goods exports due to their inconsistent contribution in R&D. Available data on IPRs for India and USA indicate that India did not increase their spending on charges for IPRs payments and receipts. Thus, India’s R&D sector is bound to produce low technology and industrial design. India gave an insignificant attention to protect of IP of individual researcher which also reduce their engagement in patenting.

If GoI wishes to pursue BDA type Act then several amendments should be done in the proposed Bill. It would help the practices of government department uniformly and remove the taboos associated with university’s involvement in commercial activities, particularly technology transfer with the industry. Establishment of Intellectual Property Management Committee at institute level would increase awareness about IP and technology transfer. However, many studies criticized that present form of this Bill cannot be successful for India. There is necessary to do several amendments in it before implementation. Government should create the awareness in public and civil society toward this Bill so they will accept the Bill with ease.

Indian Bill covers all form of IP which include trademarks, patent, design and plant variety. Thus, the definition of the term IP in this Bill is not clear. The definition should be revised so that, it’s concerned area must be concise. The reporting requirements under the Bill are extremely complicated and ambiguous, thus it must be reconsidered and simplified. The Bill prescribed that IP which arises from research undertaken through public-funds must be mandatorily protected by patents. The penalties provision in the Bill is a major disincentive for scientist and research institutions to take a public-funded R&D projects. The penalty provision should be removed from this Bill. The Bill requires every scientist or researcher to immediately inform to their concern institution about IP.

The institution shall disclose this information to the government in 60 days. BDA in USA gives the universities up to two years' time to decide whether to obtain patent on invention or not. Hence, the time period for giving information about the public-funded IP to the government should be increased.

The Bill impose that every researcher will have to inform the government that IPwill be generated by him in a 60 days. However, how does a researcher decide what IP is? So, the inventor forwards everything to institution'sintellectual property committee to decide what potential intellectual property is?The committee forwards it to the government to take afurther decision on whether to file IPR or not. Thus, the Bill will involve monumental amount of paper work.The proposed Bill largely resembles the scheme of the BDA type Act, except minimum 30% of wealth accrued from the working of the patent is shared with the individual researcher or inventor responsible for IP. The amount of royalty givenby researcher to government should be reduced. The Bill will be the arm of the TTOs to go for exclusive licenses which will be demanded by industries to safeguard their monopoly. It will deprive other start-ups/public interest entities, thus this provision should be reconsidered.

Aforesaid amendments in this Bill would be imperative to achieve following targets in India: The Act would increase the awareness of researchers and scientists towards IPRs. Researchers and scientists will get incentive to do high qualitative research in various emerging areas. Therefore, it would create conducive research environment in public-funded research organizations and private industries. Appropriate research environment would create advance technological skills in youth populations; thereby they can be entrepreneurs in future. It would also facilitate platform for research academia to sell their research output to industries with commercialization through technology transfer. Thereafter, it would bring more opportunities for manufacturing sector in international market. It would reduce import of advance technology and achieve self-sufficiency in indigenous technology. Subsequently, India's position to produce qualitative manufacturing products would improve in global market.

Demand of goods and services produced by manufacturing sector in domestic market would also get significant improvement. Subsequently, involvement of private sector in high-tech R&D would be useful to create more innovation and advance technology. Simultaneously, it would be useful to generate R&D fund for public-funded research organizations. Thus, it would make public-funded research academia financially strong and would reduce their dependency on government's R&D fund. It may be useful to create more job opportunities for youth population and make India as destination of job creator at global level. It would increase economic ability of people to buy goods and sustains the money flow in the domestic market, and create physical assets. Consequently, it would maintain the sustainable economic development and inclusive growth in India.

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