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The Rationales for Intellectual Property Rights: The Twenty-First Century Controversies

Birgitte Andersen
University of London
b.Andersen@bbk.ac.uk

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A typology on the rationales for intellectual property rights (IPRs) is developed. Focus is on natural rights and moral rationales, economic incentive rationales, increased competition and 'market protection of entrepreneurial talent' rationales, and the economic rationales of organising science, technology and creativity. Whilst reviewing the controversies surrounding IPR-legislation, the importance of this typology is justified: It will provide a good conceptual underpinning and analytical framework for achieving a finer empirical understanding of the social and economic effects of IPRs, and this understanding is urgently needed when designing policy fostering the knowledge driven techno-economic paradigm in the twentieth first century.

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The Rationales for Intellectual Property Rights: The Twenty-First Century Controversies

(Prepared for DRUID 2003 IPR round table)

Birgitte Andersen[1]

[A different version of this paper (more explicitly discussing the implications for IPRs on intangible products and processes such as software and business methods) entitled "The Rationales for Intellectual Property Rights in the Electronic Age", is forthcoming (2003) in: Jones, D. (ed.) New Economy Handbook, Published by Elsevier Science.]

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1. INTRODUCTION

Capturing value from intellectual capital and knowledge-based assets has become the new mantra. The battles are not for control on raw materials, but for the control on the most dynamic strategic asset, namely 'productive knowledge'. Finding ways in which institutions can help firms with this increasingly important practice has become an explicit agenda for many governments.

Meetings in industry, national governments, international agencies as well as consultants seems to indicate a consensus or belief that increased privatisation and recognition of the firms' intellectual capital and knowledge-based assets will enable firms to better capture the value from their productive knowledge assets. See. e.g. EU (2002)'s hearing regarding business methods patents; OECD (1999) regarding measuring and reporting intellectual capital; the Trade Related Aspects of Intellectual

[1] Dr Birgitte Andersen is Senior Lecturer in the Department of Management at Birkbeck – University of London, and she is Director for the E-commerce Programme that runs across the School of Management and Organizational Psychology, the School of Economics, Mathematics and Statistics, and the School of Computer Science and Information Systems. Her address: Department of Management, Birkbeck, University of London, Malet Street, Bloomsbury, LONDON, WC1E 7HX
Tel: +44 (0) 207 631 6848 / Fax: +44 (0) 207 631 6769 / EMAIL: b.andersen@bbk.ac.uk

Property Section (TRIPS) of the World Trade Organization which came into force in 1995 as a part of the Uruguay Round to enforce intellectual property world wide; the Bayh-Dole Act in the US in 1984 to create incentives for transferring new technology from university laboratories to the private sector[2]; the new financial frameworks from the 1980s where unprofitable firm can be listed on Nasdaq as long as they are able to report intangible assets[3]; etc. Furthermore, entering a new economy, or techno-economic paradigm, in which knowledge assets rather than physical assets are the primary sources of wealth generation and economic growth, we have experienced a tightening of the intellectual property right system in terms of (i) integrating new areas of protection (even beyond science based principles, e.g. business methods patents[4]), (ii) exclusive rights also on pure ideas (e.g. genetic codes[5] and some mathematics[6]), (iii) increased period of protection, as well as (iv) the introduction of the 'submarine patents'-scheme in the U.S.[7]

Innovation policy is designed around some IPR legal regimes. The current tightening of such policy is obviously based upon some 'visions' regarding why this might provide the answer. However, we cannot base our policy on visions alone. Firstly we need to address the question 'to what' IPR systems should suppose provide the answer?'. Secondly, we do not know the social and economic effects of IPRs, so we need to assess whether the IPR really is the best instrument for our political objectives.

Drawing upon the thinkers in the academic literature, the rationales for IPR will be reviewed and classified. Applying theoretical logic, speculations on the effects of IPRs will also be discussed. The controversies surrounding IPR legislation will form central part of the discussion. Emphasis will be on natural rights and moral rationales (section 2), the economic incentive rationales (section 3), the increased competition and 'market protection of entrepreneurial talent' rationales (section 4), and the economic rationales for organising science, technology and creativity (section 5). The rationales were discussed elsewhere with respect to IPR policy implications in the electronic age (Birgitte Andersen 2003). The main aim of this paper is to develop a 'typology' on the rationales for IPRs. The overall design, use and justification for the typology will be concluded in section 6.

In some respect the typology in this paper can be compared to the functional approach[8] and categorising of theories[9] on the benefits and costs of patents proposed

[2] See David Mowery et al (1999) and Roberto Mazzoleni and Richard Nelson (1998) for an overview and discussion of the Bayh-Dole Act.

[3] Benjamin Coriat and Fabienne Orsi (2002) argue that the most important intellectual assets in this respect are portfolios of patents and other IPRs.

[4] See EU (2002), as well as Birgitte Andersen (2003) for discussion of EU's hearing of business methods patents.

[5] See special issue of Academic Medicine (December 2002) and Bulletin of Medical Ethics (December 1996 / January 1997) for discussion on human genome patents, which is one of the most controversial topics in the current debate.

[6] See Stanley Besen and Leo Raskind (1991) and Benjamin Coriat and Fabienne Orsi (2002).

[7] David Mowery and Stuart Graham (2002) presents and discusses this scheme which allow patent applications to be updated (re-filed) while they are being processed, encouraging patent application submissions at a very early stage of the discovery.

[8] Since all activities have costs and benefits attached to them, an important issue for a functionalist approach to property rights is to attach the costs and benefits to the owners of the property relative to the non-owners, as well as relative to social and economic efficiency (Susan Sell and Christopher May 2001; and Harold Demsetz 1967).

[9] Their four categories are (i) invention motivation theory, (ii) induce commercialisation theory, (iii) information disclosure theory, and (iv) exploration control theory.

by Mazzoleni and Nelson (1998). However, in a crucial respect the typology proposed in this paper is different. Whereas, Roberto Mazzoleni and Richard Nelson (1998)'s proposed categories can be considered as empirically grounded theory, in the sense they are grounded on empirical data and analysis; the typology proposed in this paper is grounded on theoretical logic already proposed in various theoretical and philosophical frameworks of analysis. Thus, whereas their categorising of theories (including the broadness and depth in which they are discussed) is mainly in relation to areas where empirical analysis has taken place; the theoretically grounded approach in this article aims to be 'all-inclusive'. In Roberto Mazzoleni and Richard Nelson (1998)'s approach we also learn how different IPR uses apply to different industries, different firm size, and how individual versus public (e.g. university) versus private ownership on IPRs matter. The typology proposed in this paper does not aim to discuss the specificities of industries and firms etc. in relation to the IPR rationales. That is, instead of focusing on empirical relationships or result from empirical surveys, it aims to discuss the *dynamics* of the IPR system.

Of course, it would be finest to integrate the two: i.e. the all-inclusive approach to the rationales for IPRs, and the empirical results of the worth of the rationales in relation to the specificities of firms, industries and individual and public ownership. However, despite important contributions, much empirical research still need to be done on just about *all* aspects of the rationales for IPRs. Also, the state of the art regarding many of the essential empirical contributions is well summarised and discussed in Roberto Mazzoleni and Richard Nelson (1998). There are also numerous other outstanding empirical single contributions adding to the IPR debate that I cannot do justice to in the limited space allocated to this article. Thus, I have decided to mainly discuss the essential theoretical contributions to the IPR controversies, and be selective and brief on empirical contributions to the debate. As is clear from this paper, most of the theoretical contributions to the debate are historically rooted, although the focus in recent times has changed from 'the role of the entrepreneur and invention protection' towards 'appropriation from IPRs and the increasing importance of the venture capitalist as well as strategic interaction in the market place for ideas'.

With respect to the IPR context, I illustrated in previous work of mine (Birgitte Andersen 2000a, 2003) that, although protection of symbolic material and creative expression have increased the scope for copyrights and trademarks in the electronic age, the patent system protecting product and process inventions is still of primary importance, and even increasing in application, for most service and manufacturing sectors in the new economy. This paper focuses on such IPRs designed to protect the inventor from exploitation of their knowledge embodied in, mainly industrial, product and process innovations. Although, such protection mainly takes form of patents, trade-secrets and design rights are also used on occasion for such purpose. Protection of ideas embodied in symbolic material and creative expression (protected mainly by copyrights and trademarks) will only be addressed in relation to copyrights. The rationales for trademarks are of very different nature and impossible to incorporate in the short space of this article. Also, protection of 'effort' (an important part of copyright law for data base protection) will not be discussed.

2. SOCIAL CONTRACT THEORY

2.1. Natural Rights And Moral Rationales

John Locke [1632-1704] (*1980*) argued for a 'natural rights theory of the social contract'. In this context ideas are protected under the principle of natural law, in the sense that somebody's idea is a 'natural right'. It follows that governments do not create property rights but are instituted to serve as their objective guardians. Jean-Baptiste-Ambroise-Marcellin Jobard (who, in the beginning of the nineteenth century, wrote on the natural aspects of rights) was a prolific advocator of perpetual patent protection. He believed that the IPR system provide the answer to protect human creativity and personality from unfair exploitation. He introduced the term 'monautopoly' (meaning monopoly of oneself). Basically, in accordance with the 'natural rights theory of the social contract' everyone has a permanent and inalienable natural right to the sole disposal of themselves and their work.

This normative aspect of social contract is contested by a 'positive theory of the social contact'. The first advocator for this was Thomas Hobbes [1588-1679] (*1968*) who argued that there is nothing natural about a right if we need the power of government to enforce them. That is, it is impossible for government to enforce a right without implementing their views on the notions of rights and wrongs, justice and injustice, so to claim that the right are natural is a contradiction in term. Thomas Hobbes changed the very essence of the concept of natural rights to the assumption that humans have a natural inclination to preserve themselves. Assuming the rationality of humans, and to avoid a 'war of all against all' Thomas Hobbes argued for the necessity of government. The utilitarian philosopher Jeremy Bentham [1748-1832] who wrote in the eighteenth century also distinctioned between normative theory and positive theory, and he adamantly opposed the theory of natural rights. He introduced ethical principles or morals into property right theory and laid the responsibilities in the hand of the state to identify and enforce such. In this context, it is not only society's duty to protect the inventor, but also to secure the inventor a fair share of the reward when exploiting the inventor's knowledge and ideas. The idea is that it would be immoral if the law lets everybody free to use the work of an inventor without their consent and without compensation or equivalent in return. The rationale is basically that justice requires that society compensate and reward its people for their services in proportion to what they cost and how useful they are to society. The system believers here consider the most appropriate way to secure inventors is by issuing IPRs. (The classical writings on the theories of the origin of rights and social contracts are comprehensively reviewed in Itai Sened (1997) and Donald Richards (2002).)

However, the disbeliefs regarding the view that the IPR system by design, or are designed to, protect the inventor are manifold.

2.1.1. Rights versus privileges

Itai Sened (1997) who is a devoted advocator of positive theory takes a critical view and argue that we need to pay more attention to how social contracts (through which government protect the individual rights of their citizens) emerge and evolve. Government also reflect the interest groups of society.

This reflects an alternative view, that our IPR regime cannot be approached with a functional problem-solving approach, in the sense that there is nothing rational

about it. This puts the aim of this article on the rationales for IPRs into a different light. The critical theorists, Susan Sell and Christopher May (2001), presents a number of key 'moments' in the history of IPRs that eventually led to a particular IPR agreements (the TRIPS agreement being one of them). They argue that key 'moments' in the history of IPRs are not final improvements to legislation governing IPRs or the cumulation of a history of legal rationalization. Rather, the design of an IPR system at any time is based upon a particular constellation of political power, and when the power relations change, the IPR arguments become contested and open to amendment through political engagement.

Thus, ideas based upon natural or moral rights need to be seen in contrast to the positive origin of property and individual rights, where it could be claimed that society gives one some kind of 'privilege'. Fritz Machlup and Edith Penrose (1950) also argued that the term 'intellectual property right' based upon the origin of a natural or moral right (as opposed to 'intellectual monopoly privilege') was a very deliberate choice on the part of politicians working for the adoption of a patent law in the nineteenth century. This period was for liberty and equality and against privileges and monopolies of any sort.

2.1.2. The social origin of inventions and the existence of technological inter-dependence

A basic argument against IPRs in the context of natural rights and moral rationales is that technological inventions are mostly a social creation of collective, cumulative and interrelated work to which we all contribute, and therefore, no one person or firm should be able to claim the property. Ownership on technological inventions here might be immoral, and actually against the principle of moral rights, as the IPR system in this case may prevent inventors from using, or appropriating from, their own ideas they collectively have been part of creating, as someone else has been granted the IPR. Thus, it is proposed that the IPR system decreases the moral rights for most subscribers to the system.

The social origin of inventions argument (can also be termed distributed innovation processes) was put forward by Arnold Plant (1934). Research on patent scope by Robert Merges and Richard Nelson (1990) (discussed in section 4) revealed how inventions happen along multi-product trajectories that are cumulative, path-dependent and complex, in the sense that each innovation along the trajectory relies on own or others' current or past ideas. I, Birgitte Andersen (2001), used patent statistics to illustrate how technological trajectories increasingly rely on broader knowledge bases, and have also become less concentrated in the sense that a range of different firms now participate in the same technological evolution.

Furthermore, from the 'social origin of inventions'-argument suggesting that the next novelty on the road can be hit by a range of inventors, it follows that we should not reward those 'lucky' enough to be the first to hit the technological solution which is of sufficient novel character for IPR protection. Due to the randomness of the system it is almost impossible that the reward goes to those who deserve it. In addition, it can be argued that the patent system on average causes more losses than profits even to inventors, as inventors then have to pay for using the ideas they have contributed to, when other people have patented them. This problem that inventors pay to use their own ideas could in principle be solved by rewarding inventors with cash prizes rather than temporary monopolies (Lee Davis 2002). This reward system would however not solve the problem surrounding the social origin of inventions

where everyone deserves a fair share for their effort, as it is impossible to calculate the effort-share that has been conducted on an individual basis. Basically, the patent system can here be viewed as inflicting injury upon others as it is impossible to compensate or pay rewards in proportion to effort conducted and the service provided to society.

2.1.3. The reward may not reflect the value created by the inventor

In respect to the moral rationale to IPRs it is argued that justice requires that society compensate and reward its people for their services in proportion to what they cost and how useful they are to society. However, I would argue that it is very unlikely that the economic or money value (reflected in the reward system) of the idea is entirely related to the value of the idea created by the inventor. Money value tends to be circumstantial and indeed also a product of the external environment, and does not reflect the 'true' value created by the inventor. Circumstantial and external elements include economic climate and investment confidence, other inventors making complementary inventions in the 'region' of the invention (notice analogy with housing markets), strategic interaction in markets for ideas where inventors are locked in to (or out of) technological webs, etc. The belief that society, or the market economy by its own working, ensures that the 'reward system' generates rewards based upon the true value of the invention, or solely the value created by the inventor, is doubtful.

2.1.4. The IPR system is 'general' and compensates and rewards equally all novel technological ideas.

It can be argued that it is a problem that the IPR system is 'general' and compensates and rewards equally all novel technological ideas, weather they are result of great effort or a side product of accidental inventive activity. However, history has revealed that most often inventions are generally not accidental, but that to invent the unthinkable and complex, scientists must specialise. Also, in patent law today, inventions are not patentable if they are 'obvious', meaning discoverable at low cost. Yet, the troublesome question of what ideas are novel enough to be granted patent protection is often faced with great challenges. At one extreme, there is nothing new under the sun. At the other extreme, every different new combination of knowledge, creative expression or technology constitutes a new idea. In specifying the criteria of novelty sufficient for IPR protection, the designers of any IPR system must go through the difficult process of selecting a position somewhere on the spectrum marked by these extremes (Cheung 1986), and the problem-solving for this seems to become even more ambiguous within digital and micro-electronics where new combinations are produced more easily or with very little effort (Andersen 2003).

2.1.5. The Schumpeterian theory of the innovator's head-start profit

'The Schumpeterian theory of the innovator's head-start profit' is also an argument that can be used against the reward rationale for industrial inventions. The argument, is that if an inventor is really ahead other inventions, then the time interval before catching up and imitation have happened (which is difficult as it requires learning) should already secure the inventor profits and rent for their contribution; thus there is no need for government to compensate or reward inventions in the first

place. However, book-publishing or pre-recorded music, for example, where imitation is easy, would still need to be protected under 'the theory of innovator's head-start profit' principle. The essential issue is the rate by which new ideas spread (i.e. the rate of imitation and catching up). The faster the speed, the more protection is needed to ensure reward. The slower the speed, the less IPR protection is needed to ensure reward. Large rewards from the innovator's head-start can especially be obtained without IPR protection when the inventor experience increasing return dynamics and 'lock-in to their particular technological trajectories'. This can happen by random events or due to strategic corporate interaction in markets for ideas (See Andersen (2003) in section 4.1).

Richard Levin et al (1987) and Wesley Cohen et al (2000) as well as Edwin Mansfield (1986) indicated that in many industries, and in many large established firms, a head start on commercialisation of an idea is enough to yield profit from the invention, and that patents in those cases are not needed to induce the development.

3. ECONOMIC INCENTIVE RATIONALES: THE SOCIAL BENEFITS FROM PATENTS

The rationales for the IPR system are here based upon 'political expediency'. It is believed that IPRs on ideas provides the answer to stimulating a variety of different 'economic incentives' in the strategic behaviour of inventors. Basically, the efficiency of an incentive system is that it drives people to do things they would not otherwise have done, and these incentives will thus result in some benefit to society as a whole. The incentive arguments are threefold: Incentives to invent, be creative and innovate, as well as motivating the direction of such (section 3.1.), incentive to use and allocate resources more efficiently (section 3.2.) and incentives to disclose ideas in libraries and trade (will be discussed in section 5.1 in relation to knowledge spillover from IPRs).

3.1. Incentives to invent, be creative and innovate, as well as motivating the direction of such.

The basic proposition of utilitarian classical economists[10] (including Jeremy Bentham [1748-1832], Adam Smith [1723-1790], Jean-Baptiste Say [1767-1832], John Stuart Mill [1806-1873] and John Bates Clark [1847-1938] is that, as IPRs provide 'the prospect of reward', this in turn encourages creative and technological advance by providing increased incentives to invent, invest in, and further develop new ideas, and that without such the invention inducement would be weakened. Douglass North (1981) also argued that sustained innovations first began after the establishment of IPRs to rise the private rate of return for innovation. However, the 'IPR-induced incentives to invent' rationale for the IPR system rests on two assertions:

(i) Not enough inventions will be made without effective incentives: neither invention nor exploitation of inventions will take place unless inventors and capitalists believe they will yield profits which make it worth their while to make their efforts and risk their money, and

(ii) IPRs are the cheapest and most effective way for society to hold out these incentives.

[10] Cited in Arnold Plant (1934), Fritz Machlup and Edith Penrose (1950), Steven Cheung (1986), as well as Ruth Towse and Rudi Holzhauer (2002).

Along similar lines, it has been argued that even if the IPR system is not the most essential ingredient to make people invent and innovate, it helps when it comes to motivating the direction of such. That is, only the inventions with most commercial opportunities will be explored for profit purposes, so in that sense it promotes 'useful inventions' (i.e. those people want). Basically, the classical economists, mentioned above, argued that, as IPR privileges offer prizes to creative minds it arouses the mental powers and gives them a direction.

However, while there is agreement that industrial progress is desirable and inventions are necessary for industrial progress, there is less support for the above-mentioned two assertions. The arguments are outlined below.

3.1.1. Challenging assumption (i) above: Not enough inventions will be made without effective incentives**:**

(a) Inventive activity is inborn from childhood and often accidental: Many classical economists[11] (including Frank William Taussig [1859-1940] and Arthur Cecil Pigou [1877-1959] argued that IPRs are superfluous and unnecessary, as inventive activity is inborn from childhood, and as inventions are often accidental. However, as put forward in section 2.1 and in Andersen (2003), much evidence suggest inventions are generally not accidental and scientists must specialise to invent the unthinkable.

(b) The problem of 'uncertainly', 'indivisibility' and 'appropriability':

Kenneth Arrow (1962) argued that although property rights in ideas are clearly useful when it comes to stimulating inventive activity, they are nonetheless inferior to direct government investment in inventive activities. His argument was that even under patent law basic research is bound to be under-rewarded[12], so the IPR system do not stimulate inventive activity. The reasons were: 'uncertainly', 'indivisibility' and 'appropriability':

Firstly, Kenneth Arrow (1962) argues that invention production is inherent uncertain in the sense that the inventor cannot calculate the risk as in many other risk-baring or spreading activities. Hence, due to risk-averse behaviour, Kenneth Arrow argues that the patent system will not create optimal inventive effort, but under-investment.

Secondly, there is the problem that ideas and information are by definition 'indivisible' commodities. The basic argument is that, although Kenneth Arrow in principle agrees with the transaction cost argument that the only way to trade or share ideas and information is by protecting it by a property right, he still argues that such an IPR is inefficient because the inventor is loosing control of its use. Once the idea is shared or sold there is no need for the user of the idea or information to come back for more. That is, the use of an idea or information is infinite and it never faces decreasing returns to scale or is used up, so the nature of sharing or trading ideas on the market is very different from other intermediates or commodities. Use of ideas or information does not depend on the rate of production as with other intermediates, such as e.g. oil.

[11] Cited in Arnold Plant (1934), Fritz Machlup and Edith Penrose (1950), Steven Cheung (1986) and Ruth Towse and Rudi Holzhauer (2002).

[12] This shall be seen to be in sharp contrast to the 'social origin of inventions'-argument where the patent system is inefficient because it over-rewards the patentee, resulting in a variety of individual and social costs. See sub-section 3.1.2 on "Challenging assumption (ii) above: IPRs are the cheapest and most effective way for society to create these incentives"

Also, in a completely different type of indivisibility argument put forward by Arnold Plant (1934), it can be argued that, although inventions are socially created from a bundle of cumulated past and current ideas, the patent is granted on the ground of the full invention. That is, marginal patents do not exist, but the person who hits the right note at the right time gets the full monopoly reward on the particular invention, and the rest participating in the social activity of inventing are left out. It could also be speculated that this lottery version of the patent system might lead to under-investment in inventive activity for the risk averse. It is interesting to see how Kenneth Arrow (1962) focuses on how the IPR system under-rewards the one who has been granted the patent right, while Arnold Plant (1934) focused on how the IPR system over-reward the patentee.

Both indivisibility problems regarding the intangible nature of ideas (c.f. Kenneth Arrow), and the social nature of the origin of ideas (c.f. Arnold Plant), can also be considered as 'appropriability' problems (- although for different parties). This is the third type of setback of the IPR system that Kenneth Arrow (1962) explicitly mentioned. Other appropriability problems are that the owner of the idea may not be able to exploit the IPR protected idea as effectively as others, and due to uncertainly this risk is unknown, so the risk-averse may decide against using resources on research and invention. Also, a patent does not prevent anyone from thinking about the patented idea, and through pure inspiration produce a different competitive product not embodying or rewarding the original idea.

According to Kenneth Arrow (1962), these phenomena have negative implications for the 'incentive rationale' for patents. Kenneth Arrow argues that inventors might prefer to keep their inventions secret (as opposed to patent them), as once the idea is told anyone else can benefit.

In an empirical study of the data from the 1993 EU conducted Community Innovation Survey, Anthony Arundel (2001) showed how the probability that firms rates secrecy as more valuable than patents declines with an increase in firm size for product inventions, while there is not such relationship for product inventions. Regarding the controversies on appropriating the returns from research and development, and the role of patents in inventions protection, as well as inventive incentives from patents; FM Sherer (1980), Edwin Mansfield (1986), and Richard Levin et al (1987) showed in empirical surveys of the U.S. manufacturing sector that the inventive incentives from patents depend upon nature of industry and is positively correlated with firm size.

Finally, appropriability problems for the inventor also include the problems of management and transaction costs in enforcing the system. Such costs are not trivial (see next section 3.1.2) and they may reduce or undermine the efficiency of the IPR system as an incentive mechanism.

(c)Incentive to joint ventures and venture capitalists

More recently, Wesley Cohen et al (2000) showed in an empirical survey that the motives to patent often extend beyond directly profiting from the patented innovation through either its commercialisation or licensing (see section 4.1.1 on corporate strategies). In similar lines David Teece (1986) argued that if a firm can get a strong patent, it may be in a good position to bargain a joint venture or licence deal with another firm that has the production and marketing capabilities. Benjamin Coriat and Fabienne Orsi (2002) explained how changing financial regulatory frameworks in the 1980s allowed unprofitable firms to include a whole range of intangible assets in their financial statements (the most important being their IPR assets in general and their patent portfolios in particular) in order be listed on the Nasdaq for venture

capital generation. This model, together with a series of other institutional complementaries, was very successful, but also central to the creation of the bubble.

However, Fritz Machlup and Edith Penrose (1950) argued that in situations where the inventors are employed by a manufacturer or capitalist, or are manufactures themselves, they often find themselves in a bargaining situation where they have no option but to sell their patents or copyrights at a price below their value. These bargaining situations or conflicts regarding appropriability often goes against the reward system idea (see Birgitte Andersen et al (2000b) regarding revenue distribution from copyrightable material in the music industry), both in terms of the moral rights issues discussed in a previous section and in terms of the idea of creating special incentives to invent. Thus, Fritz Machlup and Edith Penrose (1950) argued "If the inventors could not hope to reap the fruits of their work, … another theory could be substituted for the weakened theory of the patent as an incentive to invent: a theory of the patent as an incentive to venture capital for the financing of the development and pioneer exploitation of inventions."

Basically, it is less risky to finance the implementation of an idea into products for markets if the idea is covered by an intellectual property. The Bayh-Dole Act of 1984 in the U.S. encourages public universities to patent their knowledge base. This Act mainly came about as an incentive mechanism to enhance knowledge spillover, by encouraging venture capitalists to invest in commercialising the (now IP protected) knowledge bases of public universities (see section 5.1.4. for critical discussion of this spillover rationale).

The function of the patent as a stimulus to the inventor's financier has been given more emphasis.

3.1.2. Challenging assumption (ii) above: IPRs are the cheapest and most effective way for society to hold out incentives to invent, invest in and further develop productive knowledge:

The innovation incentives argument is based upon the idea that the IPR system costs nothing or only impose trivial costs. In that sense society gets something for almost nothing. However, a range of thinkers, including Arnold Plant (1934), argue that heavy social costs are unavoidable. Social costs include several subject matters, as follows:

(a) The opportunity cost of investment in arbitrary technological trajectories: Diversion of activity caused by the patent reward system can be into less productive channels. The diversion could be from inventing in one field of research into other less productive pursuits, just because patent protection can more easily be obtained or to a higher extent be enjoyed in that field. Arnold Plant (1934) put forward the argument that the patent system provides specific favourable conditions for certain types of inventions and thereby diverge the activities in society into arbitrary solutions. Thus, technological trajectories will become arbitrary. Within corporate strategic management it has also been argued by Kevin Rivette and David Kline (2000) that research and development (R&D) and branding tend to be pursued in those areas in which patents can help to establish a market share. These are not necessarily the 'best' product or process innovations. The strength of the potential patent position is a leading factor in deciding what research to pursue.

(b) Administration and enforcement costs: Bureaucracy concerning administrating and enforcing the IPR system includes costs of court personnel, lawyers, IPR portfolio managers, others engaged in patent applications and litigations,

royalty management, etc., and such costs are not trivial.

(c) The monopoly or anti-competition costs of 'blocking patents'/ Setting territories: The extension of monopoly power over individual firms often goes way beyond the scope of an individual patent. The issue of strategic patent blocking put forward by Kevin Rivette and David Kline (2000) becomes relevant here. Basically, since the strength of the potential patent position is an important factor in deciding what research to pursue, it is important to consider how patent positions are strategically established. Building a wall of patents around category-leading products can help companies defend against imitators and can secure market share. An example of the importance of patent walls around technological webs is in the strategies of firms. Firms are afraid of specialising too narrowly. Many firms adopt the policy of always being at 'all platforms'.

Patent walls can be used to impose threats of patent infringement suits to block potential rivals. This is increasingly common practice. The money currently paid to IPR lawyers is unprecedented, as IPRs protect the key competitive strategic asset (or intellectual capital) of many firms. Building a patent wall around the product or process is not the only a way to hold back competitors. If your competitor has patented an invention, but has not patented the surrounding application-innovations, a corporate strategy can be to patent these, so your competitor is locked out of further developing the market, or is at least totally dependent on you. This is the essence of bracketing. It should not need to be explained that such forms of patent blocking reduces competition and hence social welfare.

Owning IPRs lets companies develop favourable partnerships and licensing relationships. Also, as one firm is not powerful enough to set standards alone, and to avoid the existence of mandatory standards, cross-licensing (often based upon strategic choice of partners) has often been the solution. Collaboration is also often around open-architecture patent pools (i.e. each participant contributes some to the development trajectory on a royalty free bases) to which they all file their relevant patents. When it comes to the specificities of the cross-licensing agreements, or sharing the royalties in patent pools, accountability and bargaining power can play a role.

(d) Opportunity costs in depriving others from using the most efficient solution: However beneficial the patent may be for the inventor who receives the privilege, the community will not automatically be benefited from an idea if it is protected by an IPR, and this in turn deprives society of the benefits that would flow from the more widespread use of these ideas. That is, although development rights are free of royalties (so spillover is in principle free), the subsequent production and trade rights embodying the ideas are not free (Steven Cheung 1986). Thus, temporary prevention, or high costs, of the use of the most efficient processes by most other producers can be considered as a welfare loss or social cost.

(e) Opportunity costs of depriving inventors what they had before (assuming invention is a social process): Assuming that invention is a social or collective process to which many contribute, the opponents of the patent system argue that a patent or copyright deprives others of what they had before (e.g. the opportunity to use the same idea that the patentee now owns).

(f) The welfare cost of broad patent scope: In the lines of the arguments in *(d)* and *(e)*, Robert Merges and Richard Nelson (1990) argued that the higher the scope of the protected idea, the higher the costs to society, and Sidney Winter (1993) focused on the costs non-free exploration of ideas, and the costs of investing in expensive innovation rather than cheaper imitation in order to avoiding the region occupied by

the patent holder. To reduce such costs, Robert Merges and Richard Nelson argued for the idea of an IPR policy of 'compulsory licensing'.

(d) The cost of patent races: As argued in section 2.1.2, the patent system can be compared to a lottery in the sense that most inventive activity is a social process, - yet those who hit the next novelty on the road get the monopoly while the rest are precluded. This might be one of the reasons for patent races, rather than sensible patenting strategies, despite being very financial resource consuming. Another reason for patent races is also the fear that competitors will be establishing patent walls or do bracketing, so firms try to patent everything to avoid such situations. Some firms interviewed for an EU fifth framework project ['Patents and services'; contract no ERBHPV2-CT-1999-06] expressed concern regarding the huge resource costs involved with such patent races, that were triggered mainly to protect against constant treats for infringement cases or problems regarding being locked-out of the development trajectory.

William Kingston (2001) also argues how, for complex technologies, patents are now used as much as a bargaining currency to prevent 'lock-out' from use of state-of-the-art components developed by competitors, as they are as stimulus to research and development. He then discusses the need for patent reforms towards compulsory licensing and open source patent pools.

(h) Royalties as social costs: A standard static efficiency argument against the IPR system is that, as the manufacturer also has to pay royalties 'R' to the inventor of the product that they produce, the price of the good exceeds marginal costs (MC + R = P), and this therefore reduces welfare. However, the system believers argue that 'R' necessarily reflects the costs of having a property right system enforcing more efficient allocation of resources (see section 3.2 below). But, the answer from the system disbelievers in this section 3.1.2 would naturally be that the social costs should not be treated as 'trivial'.

3.2. Incentive to use and allocate resources more efficiently

When understanding the economics of IPR law Richard Posner (1992) focuses on the static and dynamic effects with respect to resource allocation. Just as with property rights on land, it should follow that with intellectual property rights, ideas are used or owned by the most efficient entrepreneurs, as it make sense for the less efficient inventors to licence or sell their ideas. This is the static efficiency argument. Richard Posner (1992)'s dynamic efficiency argument reads that in a world without IPRs where anyone is free to use others' ideas, inventive activity would be biased towards inventions that could be held secret, as well as biased towards activities that involve minimum preparatory investment. Whereas an implication is that the inventor, in the absence of IPR protection, is not encouraged to conduct their inventive activities as they without an IPR will not be able to recover costs of research and development (i.e. pricing at marginal production costs in order to compete with imitators means that the inventor or entrepreneur will not recover R&D costs) or expect any special reward; the main dynamic point is that legal protection of property rights creates incentives to use resources more efficiently through investment in planning and development of resources. Innovation-enhanced competition here encourages inventors to come up with the most competitive product or process that use resources most efficient, or hold a desired new attribute, or both. Both the static and dynamic efficiency arguments rest on the assumption that ideas are scarce, just a land resources.

However, there are many arguments against IPRs as an incentive to use and

allocate resources more efficiently:

3.2.1. The deliberate creation of statue that creates scarcity

Arnold Plant (1934) argued that, whereas property rights on land under property law is useful as it creates more efficient use of scare resources, property rights on ideas are of a very different nature. Arnold Plant argued that patents are not the consequence of scare resources as in the property rights on land case, but they are the deliberate creation of statue that creates scarcity. In similar lines, Paul David (2001) also argues that the creation of scarcity within information and knowledge spaces is inefficient, as the dynamic nature of information or knowledge spaces (facing increasing returns to scale) is very different from physical land spaces (facing decreasing returns to scale). Basically, information or knowledge spaces are likely to be enriched and rendered more accurate, and more fully documented the more researchers are allowed to crumb through. Paul David argues that it is through wide and complete disclosure and the sceptical efforts to replicate novel research findings, that scientific communities build bodies of reliable knowledge.

However, whereas Paul David and Tround Olsen (1992) argue that spillover best occur through patented ideas (which they argue speed up knowledge diffusion through licensing, see section 5.1), the later Paul David (2001) presented above argues that knowledge is best developed though little IPR protection. A question that can be raised here is whether there is a trade-off between the speed of knowledge diffusion through patented ideas, and developing the best science (i.e. the best trajectories) through very little protection or through different type of open disclosure? Or, perhaps little protection is needed at an early state of the trajectory to allow for free exploration (as also suggested by Sidney Winter (1993) and Richard Nelson (2003)), but that more clear codification in patent disclosures is needed at a later stage to allow for diffusion?

3.2.2. Implications of avoiding a technological region occupied by an IPR holder

Sidney Winter (1993) argued that although it might be true that patents lead to more innovative effort, from a social welfare point of view, the IPR system does not necessarily lead to more efficient allocation of resources. He argued that inefficiencies might occur if patents are granted to inventors at an early stage of a technological trajectory. When a new trajectory is still being explored by a variety of inventors, an early granting of patents might disrupt and deprive the free exploration phase, and we might be diverted in an inefficient direction. It follows that Sidney Winter would not be a great supporter of the U.S. scheme on ‘submarine patents’ encouraging patent application submissions at a very early stage of the discovery (see section 1, and David Mowery and Stuart Graham (2002) for a detailed account on the scheme).

Furthermore, a system with strong IPR protection may result in more resources devoted to expensive inventive and innovative R&D effort (in order to avoid a technological region occupied by a patent holder) rather than more cheap imitative effort. This need for an inventor to avoid a technological region occupied by a patent holder will not only increase the cost of making a new economically comparable invention, but it might also result in inefficient technological trajectories.

3.2.3. Disincentives created by the inventor's pre-invention monopoly profits

Brian Arthur (1986) argued that in industries where the fixed set-up costs are high in comparison to the cost of reproduction, individuals and organizations have a strong incentive to identify and stick with a single option. This certainly also applies to knowledge and information based products and services. Once the costs of development have been recouped, every single additional reproduction (or re-application) of this idea pure profit. Thus, in this fashion, IPRs may encourage investment in arbitrary or sub-optimal technological trajectories and thereby create inefficient use of resources. In similar lines Kenneth Arrow (1962) argued that the patent system results in under-allocation of resources to invention. He argued that under monopolistic situations (even if temporary monopoly as in the patent case), the incentive to innovate will be lower than under competitive conditions. Although monopoly situations will increase appropribility possibilities, Kenneth Arrow argues that this is offset by the disincentives created by the inventor's pre-invention monopoly profits.

However, even under competitive conditions Kenneth Arrow (1962) argued that allocation of resources to invention is less than socially desirable due to uncertainly, indivisibility and appropriability problems (see previous section 3.1). To solve this allocation problem, Kenneth Arrow argues for government involvement and government expenditures, and he even suggests thinking about alternative methods of compensation and reward systems. However, Paul David and Trond Olsen (1992) discuss that Kenneth Arrow's argument on 'loss from monopolies' rest on the assumption that the monopolist is actively using their patented idea, but that this is only the case for a short or brief period. Paul David and Trond Olsen (1992) then emphasise how licensing is a fact of life in most industries, and how the knowledge spillover gains from such activities are under-rated (see section 5).

4. INCREASED COMPETITION AND 'MARKET PROTECTION OF ENTREPRENEURIAL TALENT' RATIONALES: INDUSTRIAL DEVELOPMENT FROM PATENTS

Here it is believed that industrial development and social welfare happens through enhanced competition (section 4.1.) or through market protection of entrepreneurial talent (section 4.2.), and that property rights on ideas (i.e. making ideas rival) are the most efficient answer to stimulate such dynamics. Thus, the rationales can also here be regarded as 'political expediency'.

4.1. The innovation enhanced competition and 'nature of ideas' argument

The fact that knowledge can be consumed jointly, and can be reproduced very cheaply means that it has some of the qualities of a public good (usually referred to as the 'expansible' or 'non-rival' aspect of a public good). But, unlike a public good, it is possible for the creator of an idea to exclude others from using it in production and trade, by use of an IPR. This rival aspect of ideas embodied in production and trade of goods and services is believed to stimulate innovation-enhanced competition, by providing incentives to innovate in using scare resources more efficiently (i.e. process invention) or inventing the next new thing (i.e. product invention). Thus, IPRs are here believed to stimulate a competitive dynamic environment as well as to strengthen

continuous innovators.

However, there are many contrary arguments in the literature.

4.1.1. The problem of patent scope and corporate strategic behaviour

It is clearly debatable whether society experiences more competition by creating temporary monopolies. The whole argument of corporate strategies surrounding IPRs and strategic patent blocking becomes relevant here. Whereas Kenneth Arrow (1962) argued that patent grants lack sufficient blocking power for the inventor who cannot fully appropriate from their idea (see section 3) so there is too little rivalry; others, such as Arnold Plant (1934) argued that patent monopolies provide such extreme privileges and appropriation opportunities to the inventor against other producers and even the consumers (see section 3) so rivalry becomes reckless. Both cases are competition distorting. Along similar lines as Arnold Plant (1934), Robert Merges and Richard Nelson (1990) argued that inventive rivalry is good for inventive progress, but that too strong patent protection will distort such progress due to patent blocking slowing down cumulativeness. The basic argument is that, most innovations take place in a social context, in the sense that complex and multi-component products are the norm in many industries, and individual patents often cover only a single component or sub-component. Basically, there is no simple 'one to one' mapping of products and property rights, but each product e.g. includes a variety of patents of different types and with different scopes and durations. The breath of the patent scope is very important for understanding the monopoly effects of the patent system. Due to cumulativeness in the innovative processes, a more narrow protection favours secondary inventions, but sacrifices the economic incentives that otherwise would be offered for breakthrough inventions, whereas broad protection has the opposite effect (as knowledge has become scarce and costly for secondary inventions). Robert Merges and Richard Nelson (1990) illustrated how history has shown that strengthening patent protection will not increase invention, due to the increased costs of the patent scope. Arguing that patents do help to reach certain ends, Robert Merges and Richard Nelson discuss the idea of compulsory licensing to eliminate some of the problems with too broad patent scope enamelling blocking power, and to enhance more inventive rivalry.

Hence, patent blocking here is argued to destroy competition. This is also why 'pure ideas' - i.e. laws of nature (physics laws), theoretical principles (e.g. some mathematics), and natural species (an exemption being the controversial right to patent gene-codes in some regions of the world[13]) - are not normally eligible for patent protection. Patenting such 'pure ideas' would block innovation and competition due to too broad patent scope, and thereby also block progress for industrial development and social welfare.

Blocking actions can also be channelled through patent or copyright assignments (i.e. outright transaction or transfer/sale of rights) or cross-licensing. Such blocking actions are also often used to produce immunity from litigation because of the high (and increasing) costs of infringement suits. Thus, the value of patents essentially depends on its blocking power. Therefore, as illustrated in Kevin Rivette and David Kline (2000) in section 3.1.2, firms lay out their patent portfolios when making long term investment decisions regarding which products to commercialise and which technological trajectories to participate in. It is essentially

[13] See footnote in section 1 for references regarding other aspects of the controversial debate.

about positioning, but signalling is also important in this game. Wesley Cohen et al (2000) have also showed in an empirical survey that, in addition to the prevention from imitating or copying, the most prominent motives for patenting include the prevention of rivals from patenting related inventions (i.e. conduct 'patent blocking' actions), as well as use of patents in negotiations and the prevention of infringement suits. The specific strategies are however industry specific. Thus, commercialisation or strategic licensing has become more important for corporate value creation than direct protection from imitation.

Ove Granstrand (1999) also sheds light on the strategic use of intellectual property rights by companies holding large portfolios of such rights. He formulates different IPR based anti-competition strategies (such as strategic patent searching and patent blocking as well as patent walls or fencing, etc.), by which companies set their territories and appropriate revenues from intellectual property rights well beyond the recovery of their R&D costs.

The historical evidence cited by Paul David (1985) and Brian Arthur (1988, 1996) suggest various circumstances that make a technological idea prone to increasing returns and lock-in and therefore competition distorting. Although Paul David and Brian Arthur emphasised how lock-in can occur from random events, Andersen (2003) shows how IPRs can enforce such lock-in mechanisms. Basically, as IPRs on a locked-in idea generates profit over time, this encourages corporate strategies to take advantage of such increasing returns dynamics to generate lock-in situations. The basic argument is that the dynamics of IPR based sectors (especially in the intangible economy where many products are purely knowledge based) the power of corporate strategic interaction and positioning have implications for the value of IPRs, so it encourages anti-competitive behaviour and enforces monopoly markets. Andersen (2003) shows how firms' intellectual capital or inventive ideas are informally protected even without the formal IPR legal framework. The situations are those in which following dynamics play a role: (i) learning effects and increasing returns to adaptation, (ii) network externalities, (iii) technological webs, (iv) informational increasing returns to adaptation, and (v) knowledge-based intangibles underpinning increasing returns to scale. Hence, in this context IPRs serve mostly as a mean by which knowledge embodied in software and some computer implemented inventions can be exploited for excessive rent creation. Therefore, one should reconsider how legitimate the market protection rationale of the IPR system is during increasing returns dynamics. This in turn also has implications for, not only a winners takes all dynamics, but also the existence of sub-optimal technological trajectories or arbitrary technological solutions (Andersen 2003).

4.1.2. Production and trade rights versus development rights

When discussing patent blocking, we need to consider what the patent protects and what it does not protect. Development rights (i.e. the right to use the idea to develop another idea) are not directly protected. However, production rights (i.e. the right to use the idea to produce) and trade rights (i.e. the right to trade a commodity embodying the idea) is protected through a patent and copyright. Yet, it could be argued that the development rights are indirectly protected by the production and trade rights, as there is no point in developing an idea if you cannot use it for commercial purposes. Steven Cheung (1986) argued that the exclusive rights to produce and trade a product also imply exclusive rights to improve a patented idea: "In short, the rule for improvement would seem to read: You may tinker with my

patent any way you please, but plan to pay me when you produce any commodity over which I have some claim; moreover, to avoid my possible excessive demands, it may be wise for you to obtain a license from me in advance". Hence, a patent does imply some exclusive rights on development to the extent that the improvement is dominated by the original invention.

4.2. The 'market protection of entrepreneurial talent' for industrial development rationale

It is proposed that efficient IPR protection allows profit-oriented firms to enter (or develop) an industry or market. This rationale of IPRs has also been compared to that of tariff protection. Just as with tariffs, a monopoly patent protects against market entry. The idea is that a temporarily production and trade privilege will allow a firm or industry to develop and mature. This, in its turn, cause (or open space for) industrial development and progress.

Edmund Kitch (1977) argued that IPRs allow breathing room for the inventor to invest in development without fear that another firm will steal the idea. Furthermore, the temporarily trade privilege in the form of an IPR should, just as with a tariff, help a firm or an industry to cover the fixed costs of inventing and setting up the producing of a new product and thereby enhance the incentive to invent and innovate (see section 3 on incentive rationales).

4.2.1. The tariff protection analogy debate

Comparing patent protection with tariff protection and comparing patent monopolies with monopoly privileges in general tend to help patent opponents and weaken patent defenders. Against patent protection during the final shaping of the patent system in the nineteenth century was the free trade argument. Those against tariffs were also generally against patents. However, those for tariffs were for patents. It was argued that IPRs are important for entrepreneurial talent to create and develop a market (just as the function of tariffs for firms and industries).

Jeremy Benthan [1748-1832] who was one of the advocators for patent protection argued that the exclusive privilege given to inventors has nothing in common with general monopolies which are so justly decried. Along similar lines, Adam Smith [1723-1790], a prolific advocator for free trade, argued that although monopolies in trade deranged the more or less natural distribution of stock in society and where therefore hurtful to society, a temporary monopoly granted to an inventor of a new machine could be justified as a means of rewarding risk and expense and thereby encourage new ventures (Fritz Machlup and Edith Penrose 1950). Luis Rivera-Batiz and Paul Romer (1991) argued that patents combined with free trade would reduce costs and enhance efficiency as economic agents can use more efficient technology developed elsewhere, as well as specialise in areas they have the comparative advance. Section 5 discusses further the view that the incentive to share ideas in trade is stimulated through patent legislation.

However, global free trade in 'science and technological'-based ideas does not make sense to a country who has no such ideas whatsoever. Also, the free trade supporters did not take into account how the efficiency of the market for ideas also depends on the efficiency of the local IPR offices, whose role is also to educate the users of the system and enforce the system (See further Jesper Christensen (2003) in section 5.1.4. regarding the role of the patent system in knowledge spillover. With

respect to cultural industries and creative expressions (which all countries have), Andersen et al (2000b) studied the global music industry where they found how the efficiency of the local the copyright system, local collecting societies and other local support institutions play an immensely important role for the grain from trade. Finally, the existence of corporate strategic interaction in the market place for ideas also distort the free trade ideology in practice. These are some of the issues that can be raised against the TRIPS agreement.

5. ECONOMIC RATIONALE OF ORGANISING SCIENCE, TECHNOLOGY AND CREATIVITY: INCREASED INFORMATION SPILLOVER

In order to secure a stream of inventions and innovations it is important that new ideas become generally known to society. The argument is that, in the absence of protecting novel ideas the inventor will keep their invention secret and it will die with them. Hence, it is in the interest of society to induce the inventor to disclose their secret for the use of future generations of inventors (see section 5.1 below), and the IPR system believers believe that IPRs here provide the answer. The economic rationale of organising science, technology and creativity also include the institutional aspects of the IPR system as an underpinning technology-support system reducing transaction costs with respect to information spillover in technological development and trade (see section 5.2 below).

Hence, the rationale is that IPRs should help to facilitate the world-wide sharing of ideas, creative efforts, and new technologies nationally and world-wide. It is believed that this creates faster knowledge spillover and a more coherent technological and industrial development, which in turn will strengthens the national or global economy. Thus the IPR rationale for increased information spillover can be regarded as a 'political expediency' rationale.

5.1. 'Incentives to disclose ideas' rationale

Granting exclusive rights to the inventor for their innovation in terms of efficient IPR protection can be regarded as a contract the inventor gets from government if the inventor agrees to disclose the idea in question (see (a) below). As the nature of an idea or information good is non-rival, such exclusive rights will also help the inventor to directly exploit, or appropriate from, the idea as a value driven intellectual capital, which in its turn will provide an incentive to share the idea in trade (see (b) below).

(a) Negotiated incentive to disclose ideas in libraries: Patents and copyrights, when filed, provide immediate information to rivals who can incorporate such into their own knowledge bases even though they cannot make direct commercial use of it. The rationale here is that IPRs are necessary as incentives to induce inventors to disclose their new inventions instead of keeping them secret. That is, perhaps there would be enough incentive to invent without patents, but they would not be disclosed due to the inventor not wishing to loose control of the idea. Hence, by issuing patents protecting the inventions, inventors agree to disclose their inventions that thus become part of society's knowledge base. To avoid interpretation of patents as 'privileges' this argument has been developed as part of 'social contact theory'. In this statue a patent is not regarded as a privilege granted by society, but a bargain between society and the inventor.

(b) Incentive to disclose ideas in trade: Secondly, a rationale is that IPRs provide direct incentives for sharing ideas through trade in the sense that knowledge,

by definition, faces increasing returns to scale. It can be argued that although knowledge is not a new feature of capitalist production, it is taking on a greater weight in the globalizing economy when protected by an IPR. Assessing this trend is complemented by the public good nature of knowledge or ideas themselves. But, unlike a public good, it is possible for the creator of an idea to exclude others from using it by use of IPRs, opening the possibility for wider commercial exploitation (Luis Rivera-Batiz and Paul Romer 1991). In this context, IPRs are in principle able to create a market for knowledge, and as ideas face increasing return to scale by nature, this give rise to increasing rent or profit as markets expands.

The information spillover effects from patents is taken serious in the formal-modelling neoclassical economic literature. Luis Rivera-Batiz and Paul Romer (1991) built upon Kenneth Arrow (1962)'s notion of perfect knowledge spillover once ideas are disclosed in a patent document (It was argued that owners of ideas thereby have lost control of appropriation from such ideas, see 3.1.1). It can be said that Luis Rivera-Batiz and Paul Romer thereby considered the communication rationale of the patent system. Basically, Luis Rivera-Batiz and Paul Romer (1991) incorporated perfect knowledge spillover and knowledge accumulation from patents directly into an endogenous growth model: "Holders of patents on previous designs have no technological or legal means of preventing designers of new goods from using the ideas implicit in the existing designs. The stock of A [knowledge or ideas] that can be put to use, with no compensation, by any individual researcher is therefore the entire stock of knowledge about the previous designs, provided that there exists a communication network that makes this information available.

However, although an IPR does not involve any research and development rights, Luis Rivera-Batiz and Paul Romer (1991) did not envisage a problem that the production and trade rights also have knock-on effects on the research and development right. Basically, what is the point in developing if you cannot exploit your idea, - so the spillover may not be so perfect after all (see Steven Chung (1986) in section 4.1.2 for discussion)

Paul David and Trond Olsen (1992) emphasized how patent monopolies may improve economic welfare when there is learning externalities or spillover. The basic argument is that patents improve economic efficiency by speeding up learning by doing and quickening the diffusion of existing innovation. Paul David and Trond Olsen criticise that the national patent systems require patent holders to pay a significant amount of annual fees and like (even after they stop directly using their patented idea but keeps the IPR for licensing purpose), reflecting the view that patent monopolies are simply imposing a deadweight welfare burden upon the economy.

However, many do not believe in the 'incentives to disclose ideas' rationale of patents:

5.1.2. The complexity of bargain agreements in social contracts

As discussed by Fritz Machlup and Edith Penrose (1950), there are many (conflicting) objections to such bargain agreements in social contracts that challenge the information disclosure and spillover rationales for IPRs:

- If inventors chose to keep inventions secret, society will not lose much because usually similar ideas are developed elsewhere (due to the social or collective nature of inventions, see section 2.1.2).
- It is practically impossible to keep ideas secret so the idea will be revealed even without an IPR. Eager competitors will find a way to find out (e.g. reverse

engineering, espionage). This argument resemble the appropriability problem in section 3.1.1.

- Where an inventor thinks that they will succeed in guarding a secret, they will not take out a patent. Hence, this argument states that patents are only taken out where the secret is difficult to keep or where others develop similar ideas. Hence, there is a net loss in the system since rational inventors would only use the patent system to restrict access to markets, and would not cause disclosure of unique inventions.
- Since patents are only granted at a certain stage of an invention, the patent system encourages secrecy in the development stage. Without patents, inventors would quickly publish their ideas under development to secure recognition and fame. Thus, patent systems encourage secrecy and when patent disclosure finally comes about, it is at a huge social cost in terms of 'lost past disclose at the development stage'. It might even be argued that if ideas are published before they have developed into patentable inventions, ideas would ripen more quickly and would become available for practical application elsewhere much sooner.

5.1.3. Invention diffusion and high barriers to imitate

Sidney Winter (1993) argues that, as resources for advancing or using knowledge are scarce and expensive in a patent system, more R&D are spent on innovative effort. However, R&D spent on innovative effort is very expensive compared to the less expensive imitative effort, in an absence of a patent system. Furthermore, Sidney Winter argues that this rival based patent system where each firms develops its own competitive trajectory, may result in too many sub-optimal solutions and arbitrary technological trajectories. Thus, Sidney Winter (1993) states that best practice productivity levels in most firms would be higher in a system without patents. He concludes that 3-years patents are sufficient for some small role for imitation, but longer period would reduce imitation entirely and raise non-optimal R&D effort. Today the length of a patent is 20 years in most countries. Despite the contribution from Sidney Winter (1993), it is evident that we know more about how the patent system affects invention and innovation from a supply side perspective (see sections 3 and 4), than the role its plays in adoption of ideas and spillover from a demand side perspective.

5.1.4. The role of public institutions in knowledge spillover to, or within, the private sector

The IPR system has also been argued to enhance knowledge spillover to the wider private community through several public institutions. Firstly, there is the most obvious (but under-researched) role of the patent office. Jesper Christensen (2003) argues that the success of the patent system is still locally rooted despite globalisation in IPR legislation. In a current debate on the issue, his basic argument (based upon a survey on what firms used the local Danish patent office for) is that, the national patent and trademark office enhance knowledge spillover from the patenting process, and should therefore not be abolished. Well-organized IPR offices provide an important role in educating and supporting the local users of the global system, as well as develop a vibrant local IPR-community by bringing users of the system and IPR service firms together.

The Bayh-Dole Act of 1984 in the U.S. is another institution that encourages spillover. This Act is mainly an incentive to encourage universities to patent their

ideas, which in turn should have a knock-on effect on venture capitalists who would then invest in commercialising the protected knowledge bases of public universities. The Bayh-Dole Act (summarised by David Mowery et al 1999, and Roberto Mazzoleni and Richard Nelson 1998) rests on the assumption that inventions serve no economic purpose unless and until they are developed into commercial use, and that a company would be unlikely to engage in the development of a university invention unless it controls the property rights (i.e. unless universities are in a position in which they can sell of licence of their invention, or if government hold them, they have commitment to non-exclusive licensing agreements; see section 3.1.1.*(c)* on incentives to venture capitalists). Although there is evidence that the Bayh-Dole Act has led universities to advertise and push their inventions more actively, Roberto Mazzoleni and Richard Nelson (1998) argue that we know very little about whether this has facilitated more technological transfer. The discussions presented in this paper can explain some of the controversial elements of the Bayh-Dole Act. For example, even if the Bayh-Dole Act may help certain ends (i.e. helping universities and individuals to develop a clear strategy regarding how to best commercialise their ideas), it is still an Act about taking very basic knowledge out of the public domain. Very basic inventions tend of have broader patent scope, which can induce welfare loss (see Merger and Nelson (1990) in section 3.1.2*(f)* and 4.1.1), or welfare loss from firms avoiding technological trajectories where basic knowledge has been made scarce and expensive (see Sidney Winter (1993) in section 3.1.2*(f),* 3.2.2, and 5.1.3). Richard Nelson (2003) advocates very strongly for keeping basic scientific findings in the public domain. In a range of empirical examples he illustrates that inventions produced by universities generally are so basic, so firms have plenty of opportunities to commercialise the ideas and patent follow-up inventions. Basically, Richard Nelson (2003) argues that it is the openness of basic inventions for multiple exploration paths in the market economy that makes the evolutionary process of technological advance more powerful. It follows that the necessity of the ownership on a basic invention as the incentive to create follow-up inventions for commercialisation is overrated. Furthermore, the objectives of firms' and universities' knowledge bases, as well as their role in society, are very different. Also, the market positioning of firms and universities are very different, and this may affect the bargaining situation.

In a somewhat different light and different context, it is also (controversially[14]), argued that public money spend on military research does not need to be a dead-weight burden to society if patented. Patents in military can enhance spillover to the civil and commercial knowledge base (Jordi Molas-Gallart, Andrew James and John Rigby 2000). It should however be noted that military inventions are often protected by trade secrecy, and that (when patented) patents containing national security sensitive information (as is often the case with military) are protected by special secrecy acts (e.g. the Invention Secrecy Act of 1951 in the U.S. case) that restrict disclosure of the invention and withhold the grant of a patent. This requirement can even be imposed even when the application is generated and entirely owned by a private individual or company.

[14] See John Alic, Lewis Branscomb, Harvey Brooks, Gerald Epstein, and Ashton Carter (1992) regarding a critical reappraisal of traditional military/industry relationships.

5.2. Rationale of uniformity, order, increased information, increased spillover and better advice

A central 'political expediency' rationale of organising science and technology at the macro level is that an IPR system also offers information on new trajectories, structural changes in technological development, and the technological capabilities of firms, industries, sectors and nations. That is, patents granted in specific fields of activity often follow identifiable trajectories or paradigms associated with the use of particular patent classes. An understanding of the trajectories being followed at a particular time may yield qualitative predictions about the nature of the improvements that are likely to be forthcoming in the near future. This information provided through the IPR system allows governments to be more effectively advised on science and technology policy matters. E.g. so far, patent statistics have shown promise and some success in analysing: international patterns of innovative activities in relation to trade and production; patterns of innovative activities amongst firms, and their effects upon competence as well as performance and industrial structure; rates and directions of innovative activities in different technical fields and industrial sectors; and links between science and technology. For the European contribution, see e.g. Birgitte Andersen (2001), and the numerous works of Keith Pavitt and Parimal Patel and colleagues at the Science and Technology Policy Research Unit (SPRU), and John Cantwell and colleagues at the University of Reading, as well as Bart Verspagen, Luc Soete and colleagues at Maastricht Economic Research Institute on Innovation and Technology (MERIT). In a recent contribution from the U.S., Adam Jaffe and Manuel Trajtenberg (2002) emphasized the direct information and communication rationales from patent grants and associated citations. Also, a national and international IPR system brings in national and international uniformity in the way the knowledge base is organised into scientific classes, so scope of analysis and comparison increases.
The transparency of systems of organised knowledge also seeks to promote cross-country trade in IPRs, and hence international integration of science, technology and creative efforts, stimulating prosperity world-wide. Basically, the transaction cost rationale for the IPR system is manifold: (i) A standardised system simplifies contracts in buying and selling knowledge. (ii) It also reduces information asymmetry and increases trust since the full idea is disclosed in a patent document. (iii) The transparency of knowledge helps to prevent the duplication of creative effort and encourages coordination and broadening of activities, allowing inventive resources to be used more efficient. Patents are therefore granted early (before invention has been carried to the point of commercial feasibility) in order to head off costly duplication of expensive development work. (The very early granting of patents is however controversial; see Sidney Winter (1993) in section 3.2.2 and Richard Nelson (2003) in section 5.1.4). (iv) Through open disclosure (i.e. reduced information asymmetry), IPRs also provide an informal or formal way of collaborating around technological trajectories.

No one really objects to the usefulness of the information spillover rationale for promoting information on science and technology matters, as well as for promoting trade in ideas and standard setting, etc.

6. CONCLUSION

The complexity surrounding IPR systems is manifold, and we cannot take the effect or efficiency of any IPR regime for granted. The IPR regime should therefore be used cautiously. In this article I have illustrated that IPR systems are not neutral; they set the rules of the game in which individuals and organisations interact, and in which corporate leaders and stakeholders are shaped and technological trajectories selected or reinforced. Due to the not neutral nature of IPR systems I agree with the view of 'positive theory of the social contract' (in section 2) that it is impossible for government to enforce a right without implementing their views on the notions of rights and wrongs, justice and injustice. I would even take the view further to argue that the existence and design of the IPR law have implications on wealth distribution in society so the moral and economic rationales of the system needs to be addressed explicitly. I therefore argue that the rationales and social and economic effects of the IPR system are vital and must be addressed at the political level. For policy design it is important to state the aims and objectives with respect to what we wish to achieve from IPR systems.

Based upon the system believers' view, a typology on the complexity of IPR rationales has evolved in this article, see Figure 1. The typology can help policy makers and academics to ask the right questions when thinking about what we wish to achieve from IPR systems.

Figure 1: Typology on the rationales for IPRs

<table>
<tr><td rowspan="2">Social contract theory</td><td rowspan="2">Natural rights and moral rationales</td><td>➢ The natural and moral right to claim the intellectual property.</td></tr>
<tr><td>➢ The moral right to compensation and reward.</td></tr>
<tr><td rowspan="5">Political expediency, as a mean to affect economic behaviour, as a mechanism to obtain welfare goals</td><td rowspan="2">Increased competition and 'market protection of entrepreneurial talent' rationales: Industrial development from patents</td><td>➢ The innovation enhanced competition and 'nature of ideas' argument.</td></tr>
<tr><td>➢ The 'market protection of entrepreneurial talent' for industrial development rationale.</td></tr>
<tr><td rowspan="2">Economic incentive rationales: The social benefits from patents</td><td>➢ Incentive to invent, be creative and innovate, as well as motivating the direction of such.</td></tr>
<tr><td>➢ Incentive to use and allocate resources more efficiently.</td></tr>
<tr><td>Economic rationale of organising science, technology and creativity: Increased information spillover</td><td>➢ Incentive to disclose ideas
➢ Rationale of uniformity, order, increased information, increased spillover and better advice.</td></tr>
</table>

The gain from stronger intellectual protection is far from axiomatic. As shown in this article, there are many controversies in the theoretical literature regarding the operation of the IPR system. In summary, many of the social contract and political

expediency rationales (based upon mainly *theoretical logic*) are problematic as they assume that all inventors (individuals or firms) are autonomous rational profit-maximizing agents, and that the aggregate of their behaviour maximise their own as well as social welfare. The arguments do not take into account the effects of technological inter-dependence, strategic interaction and collaboration in competitive markets, the specific nature of productive knowledge, power-relationships in bargaining situations, the opportunity costs of using the IPR system as a political instrument, etc.

However, we know little about the *empirical* social and economic effects. We need to establish more empirical research to explore further and more genuinely the social and economic effects of such of systems. The typology (see Figure 1) developed in this article can also assist in guiding empirical research with respect to addressing if IPR systems implement the right mechanism that will help us to reach our political aims and objectives. Basically, we cannot design IPR policy before knowing if IPRs is the appropriate policy instrument to achieve our goals in the first place.

The current need for understanding the social and economic effects of IPR policies is not only due to the emergence of new types of science and technologies. The need has also increased in importance as a consequence of globalisation policies and harmonisation of such. An aim should also be to understand the dynamic effects of the exploitation of IPRs on the general profile of corporate power, and the accountability of that power. Finally, an aim should be to understand the dynamic effects of the exploitation of IPRs on less developed regions who have expressed problems with the global IPR system in its current form, and in particular the effects of the Agreements on Trade Related Aspects of Intellectual Property Rights (TRIPS).

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