'Intellectual Property Right' Or 'Intellectual Monopoly Privilege': Which One Should Patent Analysts Focus On?

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ABSTRACT

This article challenges the existing mainstream law and economic literature arguing that patents do not, generally, confer monopolies, but that they should be understood and analysed as competitive properties. Such views do not provide vital reservations for the tightening, and increased enforcement, of the patent system that we are currently experiencing in the global economy. However, by applying an evolutionary economics perspective, combined with a modern view on conceptualising our production function, this article reach to different conclusions. It is argued that patents, generally, should be viewed as monopolies, and how such exclusive rights can produce significant social costs to business and society, and adversely affect the dynamics of innovation systems. The problem is addressed from a conceptual, theoretical and analytical perspective. Special emphasis is on the private features of patented blueprints, when they are embedded in technology, as well as the industrial organization of patent rights.

1. INTRODUCTION

Important and controversial issues have never been in short supply. The intellectual property right (IPR) debate carrying opinions for or against stronger IPR protection is no different. A central aspect of the IPR debate is whether IPRs shall be viewed as monopoly privileges or whether they are merely competitive property rights. This article positions itself in the heart of the debate, by addressing the questions: Does IPRs confer monopolies or competitive properties? Can they produce monopolies?

This debate is central for business analysts advising (i) industrialists enforcing certain industry structures and intra-industry competition/collaboration, (ii) investors or venture capitalists investing

in patent protected blueprints, and (iii) policy makers designing the law and economics agenda for the business and society, as well as competition or anti-trust law (e.g. does the concentration of ownership on patents or licensing leverage monopolies and violate anti-trust laws). Basically, whether IPRs are viewed as monopolies or whether they merely should be considered as competitive properties have impact on the analytical frameworks we apply to understand the social and economic effects of the IPR policy tool, as well as to understand business environments under IPR regulation.

A basic proposition is that the 'property right' versus 'monopoly privilege' question is important, as monopolies in trade are often associated with deranging the more or less natural distribution of stock in society and are therefore hurtful. In this context it is interesting to see how the term intellectual property right (as opposed to the term intellectual monopoly privilege), based upon the origin of natural or moral rights 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 (Fritz Machlup and Edith Penrose, 1950).

However, there now seems to be a consensus in the mainstream law and economics literature that there is no ground for assuming that patents confer monopolies, and that, if they do, this will in fact be only under rare conditions. The most notably thought provoking influential contribution to this debate in recent history is probably the one by Edmund Kitch (1986, 2000). He represents an avenue within the mainstream law and economics thinking about this problem, and he puts forward the argument that IPRs should not in principle or in practice, generally, be viewed as monopolies for conceptual, theoretical and hence analytical reasons. Furthermore, Robert Merges (2000) who has emphasized the importance of new institutional economics in understanding the industrial organization of IPRs, does in principle agree with Edmund Kitch's 'competitive property'- view on IPRs, although he argues that in practice the market structure of intellectual property rights is more like 'monopolisitic competition[1]' which he defines as a hybrid structure somewhere midway been pure monopoly and perfect competition. Robert Merges (2000) refers to how knowledge applied in production processes or projects, when it becomes privatised in the form of a patent, generally slows down (or in extreme cases block) diffusion and cumulation, although this is positively related to the breath of the patent scope. In that sense, he acknowledges how some private aspects of knowledge, which he defines as legal rights matters, can impose some costs to the system.

Such conclusions do not provide any, or only impose some (important as they may be, in the case of Robert Merges), worries for the tightening, and increased enforcement of the patent system that we are currently experiencing in the global economy. That is, we have experienced a tightening of the patent system in terms of (i) integrating new areas of protection (even beyond science based principles, e.g. business methods patents), (ii) exclusive rights also on pure ideas (e.g. genetic codes and some mathematics), (iii) increased period of protection, as well as (iv) the introduction of the 'submarine patents'-scheme in the U.S. Furthermore, meetings within 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's hearing regarding business methods patents; OECD regarding measuring and reporting intellectual capital; the Trade Related Aspects of Intellectual Property Section (TRIPS) of the World Trade Organization which came into force in 1994 as a part of the Uruguay Round to enforce intellectual property world

1 Monopolistic competition definition within principles of economics: There are many sellers, each of whom produces a slightly different product. It is very easy for new sellers to enter this market, and it is easy for existing sellers to leave the market.

wide; the Bayh-Dole Act in the US in 1980 to create incentives for transferring new technology from university laboratories to the private sector; 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; etc. (See Andersen 2004 for an overview.)

In this context, the aim of this article is to provide a vigorous challenge to the existing mainstream law and economic literature on the topic. By applying an *evolutionary economics perspective*, combined with a *modern view on conceptualising our production function*, I reach different conclusions, and argue that patents should be viewed as monopolies in most cases, and how such rights can produce significant social costs to business and society and adversely affect the dynamics of innovation systems.

A key argument in this article is that Edmund Kitch (1986, 2000) and Robert Merges (2000), as the rest of the law and economics literature, merely emphasize the degree of one-to-one mapping and inter-dependence of patents and product markets when analysing the degree of monopoly power of patents. That is, the focus is on patent blocking power in product markets. However, in this article it is argued that this view does not pick up on the *truly* private aspects of patents, which is much more than the legal privatisation aspects. It is the 'embeddedness' of a patented blueprint, when it becomes applied (i.e. becomes technology) in products and production processes, which is the true private feature of a patent, and which imposes monopoly conditions. The dynamics here is not patent blocking (important as it may be), but it is the problem of factor substitution, when the input is technology.

The problem, or the challenge to the existing law and economics literature on the subject, *"'intellectual property right' or 'intellectual monopoly privilege': which one should patent analysts focus on?"*, will be addressed from a conceptual, methodological, theoretical and analytical perspective. Focus is on the patent system, as especially the patent system has been the subject to stronger enforcement, as mentioned above.

In section 2, I review the conceptual dimension of patents. This is mainly regarding the law and economics agenda of what they are (some definitions) and what rights or privilege they hold. I conclude in line with the law and economics literature that from an *economic principle* or *definition* point of view, patents are not monopolies but merely competitive properties of exclusive rights. However, although a patent does not posses an economic monopoly *in principle*, it is not difficult to imagine how an exclusive right *in practice* might lead to a monopoly. That is, whereas Edmund Kitch (1986, 2000) and Robert Merges (2000) conclude that patents rarely led to monopolies, I argue that patents can quite easily lead to monopolies. The main reasons for the different views will be addressed in a methodological and theoretical discussion in section 3. In section 4, I review the impact the different views (as discussed in section 3) have on the usefulness of appropriate frameworks of market analysis of patents. Aspects of the complexity of the governance structure of patents will also be integrated into the analysis. Then, in section 5, I discuss the results from the analytical section (i.e. section 4) in relation to the effects the patent system has on monopolistic pricing, social costs and incentive arguments. Finally, some concluding remarks are set out in section 6.

2. THE LAW AND 'ECONOMIC PRINCIPLES' VIEW

The exploitation of knowledge embodied in product and process innovations, or related to intangible assets and symbolic material, is in most mature economies protected through the use of intellectual property rights (IPRs). IPRs came about as a natural evolution from property rights on land, capital and labour. In this context, IPRs designed to protect the inventor (or the right holder to which the

right may have been transferred) from exploitation of knowledge embodied in, primarily industrial, product and process innovations mainly take form of patents[2]. However, trade-secrets and design patents are also used on occasion for such purpose. Protection of ideas embodied in symbolic material and creative expression are mainly protected by copyrights[3] and trademarks[4]. Finally, 'effort' can also under special circumstances be protected by copyright law (e.g. for data base protection).

Intellectual property rights are important because they represent the legal mechanism for protecting (or enhancing control over) many corporate assets. The legal aspect of the IPRs is in most countries mainly a 'right to exclude' others from making, using, offering for sale, selling or importing the invention. A 'right to reward' in relation to the exploitation of the idea is also associated with the intellectual property right in most countries.

Basically, although everyday discussions and numerous professional documents by academics, policy makers, as well as IPR offices imply the assumption that the owner of an intellectual property right also possesses an economic monopoly, we need to acknowledge that, *in principle*, we need to distinguish between a property and a monopoly. Exclusive or dominant positioning of something (e.g. a house), also associated with a property, is very different from meaning 'economic monopoly' which means to have exclusive right to sell into a market without competition. Edmund Kitch (2000) and Machlup (1958) also make this distinction explicit. "From an economic point of view, "property" and "monopoly" have almost nothing to do with each other. A seller who owns his wares has property but no monopoly if many other people independently sell similar things in the market. A seller who can control the price of what he sells, because no one seriously competes with him in the market, has a monopoly but not property if he does not own what he sells." (Machlup 1958)

It follows that, *in principle* we explicitly distinguish between (i) an *exclusive right* on an idea associated with an intellectual property right, and then (ii) a monopoly on an idea that is associated with *protection from competition*.

> (i) The *exclusive right to intellectual property* in the patent case reads like something in these lines: Anyone who develops an idea exactly like one developed earlier by someone else will be formally prohibited, by a patent granted to the first inventor, from using it or selling it or importing it, unless a special contract is in place. This is even so, if the work was entirely independent.[5]

2 A patent for an invention is the grant of a property right to the inventor. The term of a new patent is 20 years from the date on which the application for the patent was filed or, in special cases, from the date an earlier related application was filed, subject to the payment of maintenance fees. A patent has to reflect a technical novelty (that is, a movement of the technological frontier). A design patent is part of patent law. Such may be granted to anyone who invents a new, original, and ornamental design for an article of manufacture.

3 Copyrights protect works of authorship, such as writings, music, and works of art that have been tangibly expressed. Copyrights last for the life of the author plus 70 years. Basically, copyright law does not require any proven artistic merit or novelty. Basically, by the nature all creative expressions are novel as they are grounded in personality. However, a copyright can also be issued on the basis of effort which is not 'original', but can easily be copied at hardly any marginal costs, whereas there are huge fixed costs of development. The idea is to protect information-based industries.

4 Trademarks protect words, names, symbols, sounds, or colours that distinguish goods and services. Trademarks, unlike patents, can be renewed forever as long as they are being used in business. By the nature of the right, there are no novelty criteria.

5 However, independent discoveries are in principle allowed in copyright law. This is based upon the assumption that it is impossible to develop new arts and crafts in the exact same form, as it is an expression of the creator's personality. However, within natural science, the same discovery is possible, since inventions in natural science is developed using laws and principles of nature rather than the personalities of the scientists.

(ii) The *protection from competition* monopoly-argument reads like the ability to sell into a market with a vertical or downward sloping demand curve, see Figure 1. This is often associated with long run persistent profits for the monopolist and a welfare loss for society, see Figure 2.

Figure 1: Comparing the characteristics of different types of market organization

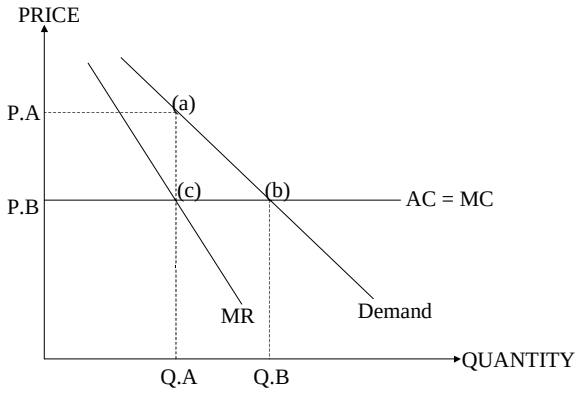
Perfect competition	**Monopoly**
• There are many small sellers each of whom produces an identical product. • It is easy for new sellers to enter this market and it is easy for existing sellers to leave the market. • A perfectly competitive firm has *no market power*: If it increases its price customers will just swap to another seller. • This means that the competitive firm is a *price taker*. • It also means that the demand curve is horizontal at a constant price.	• There is one large seller with no direct competition. • It is extremely difficult for new sellers to enter this market, and it can be difficult for the existing seller to leave the market • A monopolist has a high degree of *market power* when it can increase its price without losing lots of its customers. • This means that a monopoly firm is a *price setter*. • The ultimate in monopoly market power is if a firm, when it raises its price, loses none of its customers. This means that the demand curve is vertical, but this is indeed very rare. The more normal situation is that it loses some of its customers. This means that the firm's demand curve is not horizontal but steep downward sloping.

Figure 2. Long run persistent profits for the monopolist and a welfare loss for society

Verbal explanation

When measuring social (or allocative) efficiency and social costs we are really measuring if industrial organization and production is serving its citizens. If extra production occurs as long as society feels that the benefit (measured in terms of price, P, the citizens are willing to pay) from the extra production exceeds the costs of the extra production (i.e. the marginal costs, MC), then social or allocative efficiency is in place. If this is not the case, then society experiences a social cost. This is best expressed graphically (see graphical illustration below). - Basically, the profit-maximizing monopolist will chose to produces at the point where marginal revenue equals marginal cost (MR=MC). This results in a higher price, PA, and a lower output, QA (due to lower demand), under monopoly in comparison to a situation of perfect competition. That is, under a situation of perfect competition, the competition will hold the price, PB, where demand equals average costs which in turn equals marginal costs in the long run (AC=MC). Consequently, in accordance with this mainstream framework of analysis, the area P.A-P.B-(c)-(a) illustrates monopoly profits and the area (a)-(b)-(c) illustrates the social cost under monopoly. Thus, the basic argument reads, if a monopolist can maintain the barriers that prevent competition into the long run, and if it can remain unregulated by the government, then its profits will persist in the long run and deadweight social costs will occur for society.

Graphical illustration



3. CHALLENGE THE MAINSTREAM THINKING ON IPRS: AN EVOLUTIONARY ECONOMICS PERSPECTIVE

Although patents do not posses an economic monopoly *in principle*, it is not difficult to imagine how the exclusive right might lead to a monopoly *in practice*. A central question here is, whether a monopolistic situation regarding patents is an exceptional case or a general case. Which one should analysts focus on?

When discussing whether patents protect firms from competition in practice, the mainstream law and economics literature argues that only under very rare conditions does a patent confer a monopoly in product markets as well as in knowledge markets. The discussion is outlined in what follows below.

Basically, the mainstream law and economics literature, lists two conditions that both have to be present for an IPR to be a monopoly in product markets:

> (i). The economic characteristics of the product depends on one blueprint that has been granted an exclusive right in the form of a patent. This means that there is a one-to-one mapping between the characteristics of the product and the blueprint or patent.
> (ii). However, even in the case of (i), there is no reason for control in the product market, unless the product already faces monopoly in the market.

However, there is the variant of (i): If the characteristics of a product faced with monopoly in markets, is designed by (or dependent on) several patent protected blue prints (i.e. there is a one-to-many mapping between the characteristics of the product and the patent protected technologies embodied within it), then the 'bundle' of all the patents in question can be regarded as having monopoly in the product market, providing they are controlled by the same right-holder.

When it comes to the empirical evidence of the technology-product mapping in IPR based industries, patent statistics shows that it is very rare that there is a one-to-one mapping between a patent protected blueprint and the characteristics of a product. The normal situation is that products are complex and developed from many different technologies embodying many different blue prints

(Robert Merges and Richard Nelson 1990). Furthermore, it is also common that all the patent protected distributed knowledge bases in such complex products are owned by *many different* rights holders (Felicia Fai 2003). Both studies also illustrate how this evidence is even more true over time. From a technological system perspective, 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.[6]

On such grounds the mainstream literature concludes something in these lines (Note: the statements are my free interpretation):

a) As there is generally not a one-to-one mapping of patent protected blueprint and a product, or one owner of a bundle of technologies feeding into a single product, the holder of a patent holds no significant power in the product market.

b) A related consequence of this fact that is that the conventional monopoly framework of analysis becomes inappropriate to use for analysing the power of patents in monopolized product markets. The basic problem is that the demand curve for a product does not reflect the demand for the use of a specific patented blueprint (or a bundle of blueprints owned by the same individual or corporation). The product demand curve reflects a number of different blueprints with different scopes and durations and different owners.

c) Furthermore, a mainstream law and economics argument is that there is no demand *curve* as such for a patent, as there is only one patent of exclusive use, so there is only one price reflecting a demand *point* as opposed to a curve. Consequently, mainstream law and economics argues that we cannot map the demand curve for a specific product reflecting different combinations of quantity and price with the market situation of a specific patent. (See section 4 for further explanation and discussion)

d) Finally, although a patent holder under some rare conditions can *take advantage of* a monopoly situation, there is no explanation on how a patent actually can *produce* a product monopoly. (I.e. condition (ii) above is very essential for the patent -holder's control in the market place.)

As a result, does that mean that patents should not be treated as monopolies in economic analysis? The mainstream law and economics literature would answer 'yes'. Edmund Kitch (1986, 2000) has properly been the most prolific criticizer of using the assumption that IPRs confer product monopolies in economic analysis. He has indeed requested (in Edmund Kitch 2000) that justification is needed if this should persist.

In the context of the arguments listed within (a) and (b) above, I would like to emphasize some important effects or variables that have been overlooked in the literature arguing that patents do not confer product monopolies.

6 However, the research on patent scope by Robert Merges and Richard Nelson (1990) as well as the research on corporate innovation by Felicia Fai (2003) and Birgitte Andersen (2001) did not only reveal how product and process innovations have become increasingly complex in their knowledge bases, but also how inventions happen along multi-product or cross-industry 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. (The significance of the latter mentioned cumulative and path-dependent aspect of technological evolution will be discussed further in section 3.1)

• Firstly, it is an analytical problem that the law and economics literature fails to distinguish the difference between the blueprint nature of patents and patent markets, on the one hand, and the nature of the technology in which the blueprint is applied or embedded as well as the problem of technology markets, on the other hand. Those two have very different dynamics and different effects in economic analysis. (See section 3.1. for discussion)
• The second important variable is the role of corporate strategic interaction in patent markets places. (See section 3.1. for discussion)

In the context of the argument listed within (c) I will emphasize how the mainstream frameworks of analysis have overlooked:

• If we integrate the complexity of ownerships and market structure of patent rights and the complexity of licensing agreements we can list different combinations of quantity and price for patents and thereby draw a demand curve that we can use in further analysis. (See section 4 for discussion)

The argument listed within (d) is an important one, and something that needs to be addressed. As a starting point, I will argue two features or effects of patent protected blueprints that can produce monopolistic situations in society and that the mainstream IPR literature have overlooked. Those include:

• 'Increasing returns' dynamics produce winning technologies. (See section 3.1. and section 4 for discussion)
• The emergence of 'techno-economic paradigms'. (See section 3.1. and section 4 for discussion)
• Finally, the awkward treatment of patents as only an input variable in the mainstream production function becomes an analytical problem when understanding the effects of patents. (See section 3.1. for discussion)

Basically, I believe that these are the reasons why the mainstream law and economics literature fails to recognize how patents can be exploited for excessive profit generation in product and idea markets as well as how monopolies from patents so easily can occur, and how social costs from patents can persist over time. The issues will now be explained in turn within section 3.1. and section 4. All my arguments challenging the mainstream thinking are underpinned by an 'evolutionary economics' perspective.

3.1. Embedded Blueprints, the Characteristics of Technology, and the Implications for Monopolies

3.1.1 The case of existing monopolies in product markets and the implications for patent monopolies

Even if a patent does not automatically mean or imply a product monopoly, then I believe that a product monopoly somewhat imply a patent monopoly (or patent monopolies). This is the case, not only where there is a one-to-one mapping between the technology and the product, but also when the product knowledge base is complex consisting of many different patents of different scope and durations and owned by many different firms.

Basically, if a product faces no competition (i.e. is a monopoly), and is with a downward sloping demand curve (i.e. change in price only implies a small change in quantity demanded), the monopolistic product producer will not be driven out of business if the inventors he licences his knowledge base from increase their price. That is, instead of squeezing profits, the monopolistic producer has the possibility to transfer the increased cost on to consumer prices.[7] This provides the knowledge providers (i.e. patent licensors) with a substantial degree of freedom to control the price of both the patent licenses and subsequently the final product to which the increased costs are transferred. In that way the monopoly profit is transferred from the producers to the patent owners or controllers.

But why has this argument not been picked up in the literature before? The argument put forward here is that the mainstream property rights literature has not picked up on one of the most essential problems of mainstream economics (see subsections below), as they assume that the producer can optimise his profit by substituting his factor input (including his patent -protected blueprints) if he is unhappy with the licensing price. However, this is *not that simple* (due to the problem of embeddedness, see sections below) and as in the example above, in order to avoid squeezing the profit too much, the producer will decide to transfer as much as he can of the (increased) licensing costs on to the consumer prices instead of changing technology and hence IPR licensers.

The basic point is that, whereas the mainstream law and economics literature focuses on the direct 'exclusive private rights' control (or patent blocking power) in markets for products and services, other (such as the evolutionary economists and technology economic-historians) focus on the evolution of the most dynamic assets (namely productive knowledge) underpinning those markets and the implications this have on the power of patent rights. The dynamics here is not patent blocking (important as it may be), but it is the problem of factor substitution, when the input is technology. Basically, it is the 'embeddedness' of a patented blueprint, when it becomes applied (i.e. becomes technology) in products and production processes, which is the true private feature of a patent, and which imposes monopoly conditions.

The argument under simplicity: i.e. one-to-one product-technology mapping

Although the idea as defined in the form of a patent is a pure blueprint, then this is not the case when it is embodied in product development or production processes within firms. Then it becomes specific and particularistic in nature, as the producer or entrepreneur must innovate further in order to implement the blueprint or patented idea within context (Nathan Rosenberg 1976, Nelson and Winter 1982). Firms commit substantial amounts of resources in this way, and they also build competencies and capabilities in mastering and developing further and in capturing rent from such innovations. This differenced nature of technology when the blueprints becomes particular within each firm is indeed what differentiates firms and what is the key to their competitive edge over their closest competitors and other firms which are applying the same blueprints or other blueprints in similar lines. Furthermore, as profit-oriented firms cannot commit resources to the generation and application of *all* blueprints or knowledge that has no prospective clear relevance (indeed if they did,

7 Of course it would not be profitable in the long run if the IPR owner increases the licensing price to that level that the producer in the long run cannot stay in business, as he cannot transfer all the increased costs on to consumer prices without loosing too many of them, so his own profit is squeezed fatally.

they were not likely to survive very long), they get locked into their specific area of technological specialization and competence in which they have invested their resources. In other words, due to the particular and localized nature of technology, firms are in reality not faced with a choice of different technologies (or patent protected blueprints) at different prices to choose from at any time. This means that technological substitution, and therefore also substitution to a cheaper or better blueprints or patent at any time, is not an option. Whereas a patent is a codified blueprint and therefore tradable, it however becomes tacit and non-tradable when applied

From a longer run perspective, when products and production processes develop over time, they co-evolve with the technological components embedded in those products and production processes, and as companies have not done the impossible task of investing resources in all possible co-evolving technological and product solutions, technological substitution becomes even more impossible and costly as the product cycle or process cycle progresses over time. As a consequence, all development or co-evolution is cumulative, incremental and therefore path-dependent by nature (Nathan Rosenberg 1976, Nelson and Winter 1982), and this is also a stylised fact that has been proven by patent statistics (see e.g. Birgitte Andersen 2001, Felicia Fai 2003). This nature of dynamics results in what now has been termed technological trajectories (see section on '3.1.2.). I will here argue that it is through such increasing-returns dynamics (sometimes even stimulated and enriched by strategic interaction in the patent markets for ideas, see section 3.1.3.) leading to a monopoly-like situation in patent markets, that the price of the patent may be put above its value, and under monopolistic circumstances in product markets, this will in turn have an impact on consumer price. Thus, all the arguments, regarding how a single patent embedded in such development or co-evolution can empower the owners of such over the users of such (i.e. the licensees), becomes reinforced and even stronger over time.

The argument under technological complexity in product markets

Now let us assume that we have a situation in which products and production processes are complex, in the sense that their economic and functional characteristics, design and use depend on many patented ideas (or blue-prints) at once. To take the extreme case of complexity, let us also assume that the different patents are owned by different agents. In contrast to the mainstream thinkers presented above in section 3, I argue that this does not eliminate or reduce the monopolistic control or power associated with each patent. It can in fact be a feature that gives the patent more monopolistic power.

Basically, in such a situation a firm has invested its resources in a complex bundle of cross-applied ideas. In this case, the firm is locked into a whole technological web (or technological system), and the more technological ties in which the firm has invested its resources, the more expensive it is to substitute the technological components and sub-components with different technologies (or blueprints). The size of the co-evolving technological system in which patented blueprints are embedded can be phenomenal.

Thus, even if a licensor supplies only a small percentage of the overall bundle of ideas or blueprints feeding into a product or process, his control or power is a lot more than the relative technological contribution, as the producing firm has applied the idea within an inter-dependent system of which it has become part. Basically, when investigating the degree of monopolistic power, we have to take into account not only the technological share in terms of the % of the total knowledge base but also the economic scope of the idea within the technological system in which it is integrated.

I believe that the literature has over-emphasized the role of the one-to-one mapping of technologies and products when aiming to analyse the monopolistic power of patents. Furthermore, the literature has mistaken the specific role of the overall complex technological system in determining the monopolistic power of a patent. Basically, a pretty high control can be empowered by a licensor contributing to only a small part of the overall knowledge base of a product or a process, if the idea is well tied into an overall technological web or system.

3.1.2. Do patents create monopolies in product markets?

The mainstream law and economics theoretical literature argue that there is no self-evident reason to believe (or prove) that a patent actually can *produce* a product monopoly.

I will here argue that, the problem with such an argument is that it rests on the assumption that a patent merely functions as an input into products and production processes, and cannot be treated as a commodity (or an output) in its own right.

The problem of treating ideas, knowledge, and blueprints etc. as only input variables rest on the mainstream (physiocratic) theories of productive and unproductive labour capital and how value is created and what the production function looks like. This idea of how value is created is historically rooted from a past society where value added was created by mainly tangible capital and measured in terms of physical units where output (Y) is a function of physical capital (K), physical labour force (L), materials (M), energy (E) and service (S). (Birgitte Andersen and Marva Corley 2003). However, the modern world is very different, and with the emergence of the knowledge based economy and network society, the physical paradigm is of the past, and intangible capital as well as intangible output (e.g. knowledge intensive business services) has taken on a greater weight. (About 75% of GDP in developed countries is intangible).

In this context a patent license naturally feeds into the category (S) of a knowledge intensive business service input, and patent ownership naturally feed into an intangible capital (involving a re-definition of the physical capital variable (K)), and finally, an patent output should also be acknowledge within the production function framework (involving a re-definition of the physical output variable (Y)). Currently, corporate and national accounts have begun to recognize such problems and adjust their accountancy frameworks (although they are a long way from solving all the challenges regarding conceptualising and measuring the knowledge intensive business services and the knowledge production function which is very different from the conventional production function). However, mainstream law and economics theories are still closed up in their own frameworks of analysis, which probably is the reason for their awkward treatment of the role and scope of patents in economic systems.

Thus, the conventional view on the production function raises two essential problems when investigating the effects of patents:

(i). Basically, it is a problem that a patent is only treated as an input variable.
(ii). Furthermore, with the emergence of complex products and production processes where output is created by a variety of integrated and interrelated knowledge based ideas (or blueprints) owned by a variety of individuals and firms, it is a problem that the conventional production function does not take into account system effects of IPRs in the network society (see "*The argument under technological complexity in product markets*", above, where this view was already discussed)

Thus, what is important is not merely the market for products and processes embodying the patented ideas, but it is the market for the patent protected productive knowledge in itself. So what are the monopolistic nature of patent markets?

In the section 3.1.1. above, I explained how a patent so easily in practice can function as a monopoly for the single product producer, due to past invested resources and accumulated capabilities in mastering and capturing this blueprint locks the producer into this single option. However, many patents or blueprints have tremendous success throughout the economy as they diffuse across society or sets technological standards within industries. That is, there has to be distinguished between those technological trajectories which are specific to a particular product, firm, or industry and those which are of general importance throughout the economy (Nelson and Winter 1977). Freeman and Perez (1988) differ from Dosi (1988) in the sense that they refer to the Schumpeterian type of meta-paradigm of a dominant technological (or techno-economic) regime that rules for several decades, whereas Dosi refers to a type of (micro) paradigm or trajectory, which is specific to a particular technology or product. Dosi's type of micro-paradigm, is now conventionally termed a technological system.

The dynamics leading up to such paradigm development, or why certain technological trajectories become winners in society, is manifold. The costs of the up front investment which lead investors to stick to single options, as well as the development and resources embedded in technological webs or systems and the capabilities in managing those are all important factors that have already been discussed in this article. Brian Arthur (1986) provides an overview of different types of increasing returns and network economics mechanisms where one technology comes to dominate, so that all follow-up and application inventions become dependent on this one technology. In Birgitte Andersen (2003) I discuss those in relation to the dynamics of IPRs in the electronic age, where I illustrate how IPR licensors can experiences an increasing monopolistic situation from such dynamics. Such theories are also supported by much evidence on patent statistics (see e.g. Birgitte Andersen 2001) which shown how patenting records for technological development are instituted into certain paths rather than other.

3.1.3. Patent blocking actions and strategic interaction

It is clearly debatable whether society experiences more competition by creating temporary exclusive rights or monopolies. The whole argument of corporate strategies surrounding IPRs and strategic patent blocking becomes relevant here.

Blocking actions through patent scope

Whereas Kenneth Arrow (1962) argued that patent grants lack sufficient blocking power for the inventor who cannot fully appropriate from their idea once it is revealed, 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 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, as most innovations take place in a social

context, in the sense that complex and multi-component products are the norm in many industries, individual patents often cover only a single component or sub-component. Furthermore, each blueprint form part of a variety of technological trajectories. Thus, the breath of the patent scope is very important for understanding the blocking 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.

It should here be noted that, whereas Robert Merges (in Robert Merges and Richard Nelson 1990) does consider the *direct* importance of patent scope in relation to patent blocking, he (i.e. Robert Merges 2000) underestimates the short-medium and long term effect this has on the creation of monopolistic situations, due to he disregard the problem of factor substitution (or patent substitutions) and pre-invested sunk costs; see section 3.

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) - 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 through patent assignments and positioning

Blocking actions can also be channelled through patent assignments (i.e. outright transaction or transfer/sale of rights) or cross-licensing. Ove Granstrand (1999) 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.

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), 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 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.

Blocking though enforcing increasing return dynamics

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, I would like to argue how IPRs can enforce such lock-in mechanisms. Basically, as patents 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 patents, so it encourages anti-competitive behaviour and enforces monopoly markets. In this context. I, Birgitte Andersen (2003), show 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 patents serve mostly as a mean by which knowledge embodied in product and process inventions can be exploited for excessive rent creation. Therefore, one should reconsider how legitimate the market protection rationale of the patent system is during increasing returns dynamics. This in turn also have implications for, not only a winners takes all dynamics, but also the existence of sub-optimal technological trajectories or arbitrary technological solutions.

Informal blocking actions on research and development, enforced by patent protected blocking actions on exploitation

Furthermore, 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.

3.1.4. Overview of criteria for monopoly in conventional product markets and idea markets

Of course the degree of scope for monopolistic power differ across technological sectors, industries and over time, but using above discussion as a framework for analysis, we can define some basic criteria to identify the degree of monopoly power of a patent:

One-to-one mapping:

• The degree of monopoly power of a patent increases, the more a product or process's economically distinctive features depend on the claims of a patent.

Embeddedness and time:

• The degree of monopoly power of a patent increases as times goes by. This is due to past investments and sunk costs increases over time, while capabilities and competencies become more specialised, so changing technological trajectory becomes less an option, and patent users are therefore forced to stick with their option.

Co-evolution in complex systems:

• The degree of monopoly power of a patent increases, the larger[8] and *tighter integrated* a technological system is, so that one patent is essential to the economically distinctive features of the overall system consisting of many inter-related blueprints forming part of a product or process.

Size matters:

• The degree of monopoly power of a patent increases, the higher number of patents that a firm own or control that is designing the economically distinctive features within one product or a technological system. Evidence has illustrated that firms patent more broadly for those reasons.

Strategic interaction:

• The degree of monopoly power of a patent increases, the more strategic interaction there is in the market place for ideas. Different rights holders controlling several patents that are designing the economically distinctive features of a product or technological system, can enforce a monopoly providing they collude or conduct strategic interaction

Breath and scope:

• The degree of monopoly power of a patent increases, the broader a patent is applied in technological systems or techno-economic paradigms. It is commonly argued that there is *opportunity* for broad claims in new fields fuelled by basic or break-through inventions, to bring about an opportunity for a monopoly. However, whether there is an opportunity for broad claims in basic inventions is a problem *in practice*, is debatable. In the one extreme, Edmund Kitch (2000) suggests that there is no monopoly opportunity, as he claims that the

8 It should be mentioned that a complex knowledge base of products may not only be a reflection of the attributes of the given product. That is, that a product contains many different patents may not be a reflection of that it has many different knowledge bases (i.e. a reflection of complex product characteristics), but it may be a reflection on something completely different. It may be a reflection of the operation of the patent system. Patents claim have to satisfy the criteria that the idea is new and non-obvious, but at the same time it builds on elements in previous related work. Thus, to make the claim more significant (i.e. eliminate citations), the applicant has the opportunity to narrow the claim. Thus there may not be a linear relationship between the complexity of the product and the number of patents embedded as patent scope is likely to decrease over the product life cycle. E.g. if we anticipate that product markets and knowledge markets co-evolve (a stylised fact and now common assumption within the literature on industrial dynamics, see section 3.1.1, as well as Andersen 2001 for an overview) we can expect that in a well developed field the applicant narrow the patent claim to exclude related and the prior ideas. This will result in products including a whole range of narrow claims, rather than a few patents including lots of citations.

demand for basic inventions is very low as much work needs to be done to achieve commercialisation or to bring the product embodying the idea to the market. Basically, he casts doubt on, how there can be a monopoly when there is no, or very little, market or demand for products embodying the basic idea. However, on the other extreme, I would argue that technological leaders within product industries are established very early on (due to the broad patent scope of successful early inventions), and they tend to persist over time (generally to a lesser extent, but sometimes to a greater extent), until new break-through inventions cause a change in techno-economic paradigm (Cantwell and Andersen 1996, Andersen 2001, chapter 7 and 8). This is mainly due to technological and economy lock-in to past investments.

To make a general statement I will conclude that enforcing and maximizing rent in patent monopoly involves two conducts:

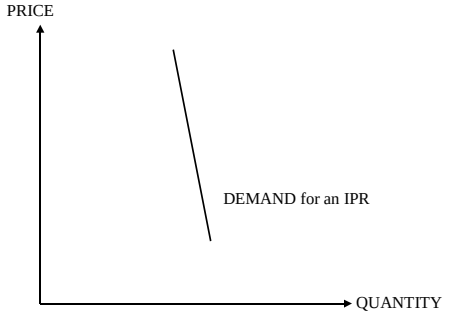
- Maximizing rent through positioning (i.e. the more you own of the core knowledge-bases embodied in technological systems, the more exclusive rights you control, and the more power you have).
- Maximizing rent through scope: (i.e. the more widely your single patents are applied, the higher value you create through licensing revenue)

Overall, I argue that, even if a patent in principle is an exclusive right, there are good reasons to believe that it quite easily can lead to a monopoly like situation in practice, both at the level of individual actors (or producers), industrial sectors, and entire societies.

4 APPROPRIATE FRAMEWORKS FOR MARKET ANALYSIS OF PATENTS

Basically, it is the cumulative, incremental and path-dependent nature of science and technological progress that lock businesses and society into trajectories of development, and which subsequently empower IPRs into a monopolistic like situation. In other words, the patent demand curve tends to be very steep, as the IPRs face no or very little competition; see Figure 3. Thus, even if this type of diagram is generally not (or only under certain rare conditions) appropriate to illustrate the *direct effects* of patents on product markets, I believe that it is a good proxy for understanding markets for patent protected blueprints.

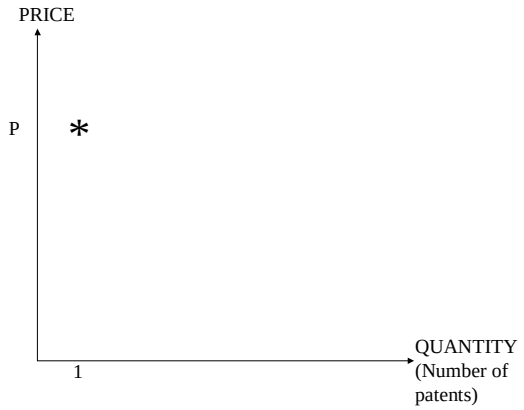
Figure 3: Graphical illustration of price-elasticity in the demand for successful basic inventions (almost vertical).



However, in this context it is important to mention that it is now also conventionally argued that this type of analytical framework should not be applied directly to patnet markets, because it does not match the characteristics of a market for a patent. The arguments have in particular been put forward by Edmund Kitch (1986, 2000) and somewhat supported by Robert Merges (2000).

One argument of the mainstream law and economics literature is that the market demand curve illustrating different combinations of price and quantity cannot be applied to directly to patent markets, as there is only one patent. Basically, there is just one demand point (as opposed to demand curve) in the market illustrating the combination of the one supply (i.e. one patent or one licence) and the one related price. See Figure 4. The situation presented in this argument can actually be compared to auction markets. That is, assuming that the right-owner acts rational, the point in Edmund Kitch's figure (see Figure 4) must be the highest price offered by any bidder.

Figure 4: Market for Patent Itself: One Patent Equals One Unit (Edmund Kitch 1986)



The unit of analysis is crucial here, and although Edmund Kitch (2000) somewhat recognizes the importance of the units of analysis, he does not give it any major importance. Instead, he rather reinforces his argument of how there is not a 'curve' of demand within the market for patents.

However, I believe that we without difficulty can identify some specific examples of how the unit of analysis matters for the application of the diagram to the market analysis of patents. Basically, the market diagram is so basic so it is not meant to identify the units of analysis. It just illustrates the market relationship between quantity and price and it is up to the analysts to identify, in relation to the question of analysis, how quantity and price should be conceptualised and measured.

I will now illustrate two different applications of the diagram in relation to the two different ways in which rent is created in patent monopolies. They were identified in section 3.1 as: (i) Maximizing rent through positioning, and (ii) Maximizing rent through scope.

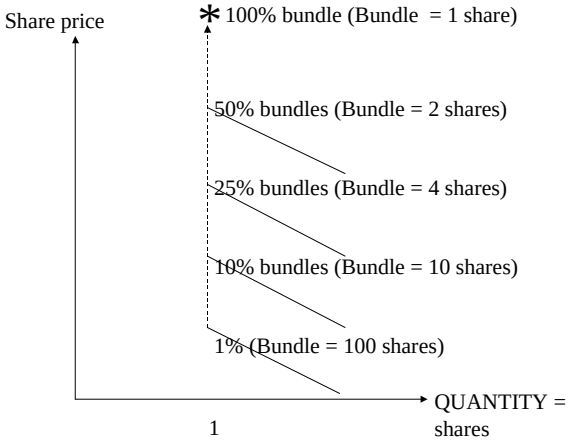
(i) Maximizing rent through positioning

A situation that has not been addressed in the intellectual property right literature is the complexity of ownership. When Edmund Kieth (1986, 2000) and his colleagues argue that there is only one unit, i.e. a patent, and one price, they fail to recognize that there is nothing that stops the intellectual property right in being shared among or sold to a range of different actors that then become share holders, and all those shares can be traded on the markets at different prices. This is in fact the rule

of the game in many industries[9] where it is found more important own the exclusive rights (or parts of exclusive rights) on a patented idea for rent generation than to licence it. In the case illustrated in Figure 5, the quantity reflects patent shares (1 share = 1% ownership) and the price reflect the price per share.

Obviously, if the price increases the demand will decrease. However, in the Figure 5 I have also accounted for that many agents would like to buy a high percentage of the total amount of shares in order to increase market power through positioning. This is illustrated by bundling the 1 % shares into bundles including 10% of shares, 25% of share, 50% of shares and one including the total number of shares. Given the desire to own such bundles of shares, it is easy to imagine that economic agents are willing to pay a higher price per share providing they are able to buy a large bundle (i.e. a large % of the total number of shares). For graphical illustration of the phenomenon, see Figure 5, that illustrates how an 'attraction to a potential increased power' from larger bundles of shares moves the demand curve upward. As in Figure 4, there is no curve for a 100% patent ownership.

Figure 5: Market demand for patent shares: One share equals 1 % patent ownership.



However, there is also a variant of Figure 5. Assume that total patent shares reflect a patent that is forming an important part of a technological system (based around a project group) or a techno-economic paradigm effect (i.e. where basic blueprints becomes of general importance throughout the economy) (as defined in section 3.1), then this may involve an increase in price due to the increased market power patents under such conditions. Thus, this desire to maximize rent through positioning will result in an upward movement of the all demand curves.

(ii) Maximizing rent through scope

Understanding the functioning of licensing markets is an interesting economic problem that should also be dealt with within monopoly analysis. Furthermore, licensing markets are increasing in importance in most industries, and this is a topic that needs to be dealt with in a systematic way within the IPR literature. Basically, although there is only one patent, then the use of it can still be duplicated in licensing markets. A rationale for the patent owner here is of course that, the more widely a single patent is applied, the higher value from it is created through licensing revenue.

9 The copyright based music industry is probably the most well know industry is this respect, but this type of industrial organization is also common in patent industries (e.g. the electronic and electrical industries).

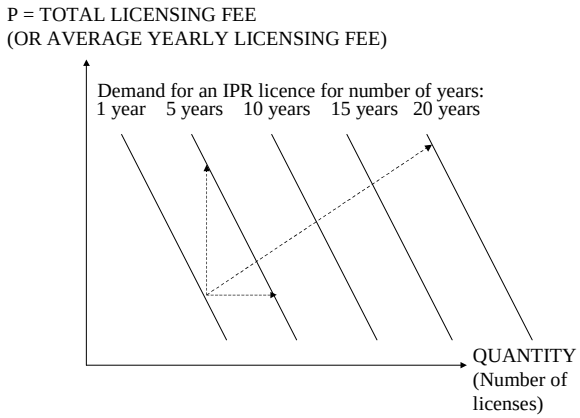
If quantity, Q, illustrate numbers of licenses, and if the price, P, illustrates the total or yearly average licensing fee agreed in a single contract, then it is easy to imagine that a higher licensing fee will only appeal to a fewer number of clients, so demand will decrease, and, as a result, a smaller quantity will be licensed. Hence, also here will the demand curve be downward sloping.

Furthermore, as the agents licensing the patent has to invest a significant amount of resources in order to apply, and further develop, the blueprint or licence within the context it will be used (see section 3.1), they are of course interested in being able to licence the permission to use the blueprint over a number of years. That is, what is the purpose of making the up front investment in applying the licence, if the investment costs can hardly be recovered or if profit cannot be captured in the long run? Thus the terms of the contract in terms of numbers of years the licence cover is important.

The situation of one longer term contract

Consequently, if the total (or perhaps even yearly) licensing fee is held constant, but the terms of the contract has increased in years, the quantity of licenses obtained will most likely increase, as the demand will probably increase. Another situation in similar lines can of course also be that that licensees are happy to pay more in both total (or perhaps even yearly) licensing fees if the licensing contract are over a longer number of years. This is because the licensees are now able to plan, and therefore invest and allocate their resources more efficiently when implementing the blueprint in their products or processes. The incentive is to profit from their up-front investment over a number of years. Also, in that way, longer contracts also make the relationship with the licensor less risky, *ceteris paribus*, as the licensees know that the contract will not suddenly terminate. For graphical illustration of the phenomenon, see Figure 6, that illustrates how licensing contracts over longer amount of years moves the demand curve up and outward towards the right.

Figure 6: Market for a patent license under different lengths of contracts



The situation of rolling short term contracts

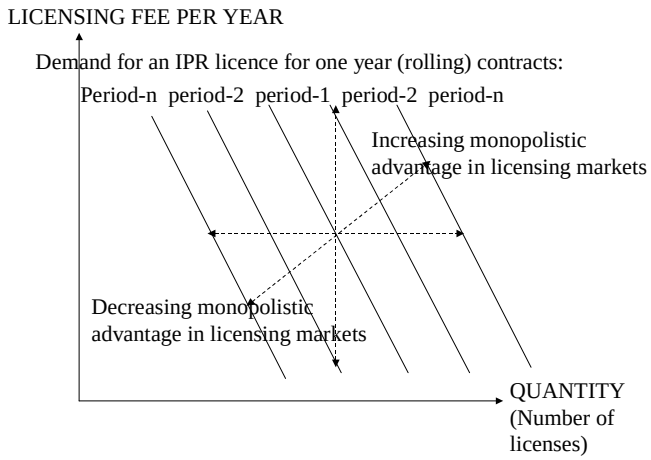
However, it is not un-common that it is in the most interest for both the licensor and the licensee to organize their business in rolling short term contracts (rather than one long contract), say yearly

contracts for the sake of the argument, which are then subject to renegotiating each time the contract ends. The reason is a combination of managing profit and managing risk.

From the perspective of the licensor, there is the possibility that the value of the licence increases over time if it becomes applied in a string of successors of product and process innovations. Basically, due to the co-evolutionary development processes between technological development and the product or production environment in which the blue-print is embedded, the value of a license tend to increase over time for the firms (i.e. licensees), as it become increasingly costly or impossible for the firms to change development path (see section 3.1. above). Thus, it can easily be imagined that in such situations the users of the blueprint (i.e. the licensees) are willing to accept to pay a relatively higher licensing fee as times go by. This is identified by upward moving demand curve in Figure 7 below. However, as the licensees of course do not know the value of the licence *ex ante* it is very difficult for the licensor to bargain a high fee in the first contract, so he prefers to provide the first contract at a reasonable low fee, and then subsequently hope to bargain a higher fee at a later stage in a subsequent contract.

From the perspective of the licensees, they have to manage their risk as well as profit, so instead of writing a long term licensing contract (i.e. the situation in Figure 6), they often prefer a short contract period where they can experiment and try out new ideas to test the potential of the blueprint. If the license has not proven of particular success for the licensees, many new contracts may not be obtained (illustrated by a decrease of total number of licensing contracts, i.e. a leftward moving demand curve) or the licence-fee can be decreased (illustrated by a downward moving demand curve) in subsequent contracts. However, if the licence has increased in value for the licensees for various reasons (such as successful implementation in product or process innovations, market advantage, or technological lock-in, etc.), the licensee will indeed like to negotiate a new contract. However, as mentioned in the section above, now the licensor is in a stronger position and might be able to bargain for an increased licensing fee.

Figure 7: Market for a patent license over rolling contract periods*



* *Note: Period-1 is the first period the blue-print is on the licensing market. New entries can of course happen in all subsequent periods of contract. This is in fact the whole point of the right or left ward moving demand curve.*

Basically, in order for the licensor to manage his long-term profit, and in order for licensees to manage their risk, licensing agreements are often very short and subject to re-contracting and re-negotiation. These negotiations are of course individual and client specific.

However, this does of course not mean that there is never an overall trend, because sometimes there are generic blueprints of more general importance, that diffuse across a whole technological system or techno-economic paradigm for a number of years (see section 3.1). Rent can in such situations be maximized though the technological system or techno-economic paradigm effect. In Figure 7, which illustrates how rent is created from licensing fees, the technological system, and techno-economic paradigm effect (i.e. where basic blueprints becomes of general importance throughout the economy), is illustrated by an increasing number of licences taken out over a number of periods (c.f. movement of demand curve to the right), and as the technology is so pervasive throughout the industry or economy everyone simply has to obey to the standard, so higher licensing fees can be obtained (c.f. upward movement of the demand curve). In total, those effects illustrate a force of an up-rightward moving demand curve where higher quantity is demanded and the willingness to pay a higher price. The loosing blueprint, embedded in a loosing technological trajectory, will of course experience the dynamics of being driven out of the market as it will experience decreased demand, while accepting a lower fee, in order to maximise the rent from the patent.

5. MONOPOLISTIC PRICING, SOCIAL COSTS AND INCENTIVES

One of the features of a monopoly (as presented in the analytical framework discussed within section 3 and 4 of this paper), as opposed to a situation of perfect competition, is that prices can be set above the point where it is social efficient, and that this provides monopoly profit to the inventor or right holder, and a social cost to the rest of society; see Figure 1 in section 2.

However, Edmund Kitch (2000) and Robert Merges (2000) defend the up-marking of price above marginal costs of production on the ground that (i) there are a lot of costs associated with maintaining and keeping and trading an IPR that do not show up in mainstream analytical diagrams, and that (ii) the system must allow for some profit from an IPR in order to create incentives to invest and invest in the new ideas. Both are indeed important aspects of the rationales for the IPR system. They will now be discussed in relation to supply side cost arguments (section 5.1), incentive arguments (section 5.2), and social cost arguments (section 5.3).

5.1. Supply side costs arguments

It is factual that there are a lot of costs associated with maintaining and keeping and trading a patent. Those costs do not show up in the monopolistic diagram, but they need to be covered if the inventor shall have any incentive to perform his activities and share them with society. Those none-production costs which are ignored in the pricing part of the market analysis in the mainstream monopolistic framework include: (i) research and development costs, (ii) the fee to government of holding the licence, and those costs increase yearly over the life span of the patent in most countries in order to encourage the right holders to put their idea in the public domain, (iii) marketing costs, (iv) transaction and contracting costs, (v) enforcement costs, etc. Basically, the fact that many knowledge based goods (such as patents) are priced above their marginal costs of production does in

theory imply that they are monopolies and purely results in welfare loss, but as emphasized by Edmund Kitch (2000) and Robert Merges (2000), the reality may be very different.

Furthermore, it is true that pricing mechanisms are complex and that price discrimination is common practice in monopolistic (as well as competitive markets). However, as argued by Edmund Kitch (2000), such differentiated pricing can in fact be to the advantage for both the seller and the buyer. For these reasons again, it is correct, as argued by Edmund Kitch (2000), that that pricing above marginal costs of production does not always automatically imply monopolistic anti-competitive behaviour.

Nonetheless, I would still argue that because existing analytical frameworks do not encapsulate all the costs or complexities associated with the patent trading system, this not-transparency does *not justify* up-marking of price or can serve as any evidence that there is not a monopolistic situation. Rather, it simply calls for the development of better analytical frameworks for analysis. Better analytical frameworks also need to be developed on the ground that, under non-transparent pricing mechanisms firms will behave opportunistic. Indeed, according to Oliver Williamson it would not be rational if they did not. So to conclude that up-marking of price is simply no serious problem in practice because our analytical framework is ineffective or because the market in non-transparent is questionable.

'The Schumpeterian theory of the innovator's head-start profit' is also an argument that can be used against the 'up-marking of price' (as well as the reward rationale, see incentive in section 5.2. discussion below) 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 to cover their costs of their contribution; thus there is no need for government to compensate (or reward for that sake) 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 profit 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 section 3.1). 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 cover costs and yield profit from the invention, and that patents in those cases are not needed for this (or to induce the development).

In any case, even if the patent system helps certain ends on the supply side in terms of covering certain supply side costs, the patent system is a mixed blessing as it also lead to certain social costs (on both the supply and consumer side), and, as argued by a range of scholars, such costs are not insignificant (see section 5.3 for an overview.).

5.2. Incentive arguments

The whole monopolistic pricing discussion takes a turn when the argument is that *monopolistic pricing is simply a necessary condition* to create incentives to invent. Basically, if there is no possibility for exploitation, the inventor would not have any incentives to invent, the argument states. This is

possible one of the most cited arguments in all the literature on patents. Basically, the 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] argued 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.

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 regarding the first assertion, (i), is presented below, whereas the argument regarding the second assertion, (ii), is presented together with the 'social costs from patents' discussion in section 5.3.

5.2.1. Arguments challenging the assumption: Not enough inventions will be made without effective incentives:

(a) The lottery version of the patent system might lead to under-investment in inventive activity

The social origin of inventions argument (can also be termed distributed innovation processes) was put forward by Arnold Plant (1934). In this context it is argued that technological inventions are mostly a social creation of collective, cumulative and interrelated work to which we all contribute. Ownership on technological inventions here might be immoral, and actually against the principle of natural or 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. However, even if 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 solution with sufficient novel character for protection at the right time gets the patent on the particular invention, and the rest participating in the social

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

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.

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

Kenneth Arrow (1962) argued that although property rights on 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[11], so the patent system does not stimulate inventive activity. The reasons were: 'uncertainly', 'indivisibility' and 'appropriability':

Firstly, Kenneth Arrow (1962) argues that invention production is inherently uncertain in the sense that the inventor cannot calculate the risk as in many other risk-bering 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 revealed (or 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. 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 (see the social nature of the origin of ideas, as explained in (a) above). 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 reasons). This is the third type of setback of the patent system that Kenneth Arrow (1962) explicitly mentions. Other appropriability problems are that the owner of the idea may not be able to exploit the patent 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. Furthermore, in an argument in similar lines, Anthony Arundel (2001) showed, in an empirical study of the data from the 1993 EU conducted Community Innovation Survey, how the probability that firms rate 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

11 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 (a) above.

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 section 5.1. and next section 5.3) and they may reduce or undermine the efficiency of the patent system as an incentive mechanism.

(c) Incentives are for joint ventures or 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. 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 to 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 (2000) 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 1980 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. 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 or licence of their invention, or if government hold them, they have commitment to non-exclusive licensing agreements). 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. However, 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 as productive knowledge has become scarce and expensive (see Merger and Nelson (1990) and Sidney Winter (1993)). 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. 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.

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

(d) Inventive activity is inborn from childhood and often accidental:

Finaly, many classical economists[12] (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, this has not been proven empirically. Rather, much evidence suggests that inventions are generally not accidental and scientists must specialise to invent the unthinkable.

5.3. Social costs arguments

If we recall the arguments put forward by Edmund Kitch (2000) and Robert Merges (2000), they defended fact that the patent system provides the opportunity to up-mark price above the marginal costs of production, due to there is a range of costs on the supply side are that not accounted for in the current analytical frameworks, and they of course need to be covered to provide a sustainable productive system (see section 5.1). However, in the patent system also leads to the creation of a range of social costs and they have not been accounted for (or they have been treated as trivial) in the mainstream law and economists argument, as will be clear in what follows. Furthermore, the invention incentives argument is also based upon the idea that the patent system costs nothing or only imposes trivial costs. In that sense society gets something for almost nothing.

However, a range of other scholars, including Arnold Plant (1934), argue that heavy social costs are unavoidable so the IPR system is really a mixed blessing. Social costs include several subject matters.

5.3.1. Arguments challenging the assumption: The IPR system only imposes trivial costs, and it is the cheapest and most effective way for society to hold out incentives to invent, invest in and further develop productive knowledge:

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

(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. Thus, 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 patent system includes costs of court personnel, lawyers, patent 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. See section 3.1.3.

The issue of strategic patent blocking put forward by Kevin Rivette and David Kline (2000) also 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 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 patents 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 a patent, 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 (see 5.2.(a) above), the opponents of the patent system argue that a patent 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) above, Robert Merges and Richard Nelson (1990) argued that the higher the scope of the protected idea, the higher the costs to society. To reduce such costs, Robert Merges and Richard Nelson argued for the idea of an IPR policy of 'compulsory licensing'. Sidney Winter (1993) focused on the costs non-free exploration of ideas, where he emphasized the costs of investing in expensive innovation rather than cheaper imitation in order to avoiding the region occupied by the patent holder.

(d) The cost of patent panic:

As argued in section 5.2.(a) 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 patent while the rest are precluded. This might be one of the reasons for patent panic where everyone patents everything they come across, rather than sensible patenting strategies, despite being very financial resource consuming. Another reason for patent panic 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 panic, 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 patent 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 inventions and long term efficient allocation of resources. But, the answer from the system disbelievers in this section would naturally be that the social costs should not be treated as 'trivial'.

6. CONCLUSION

The question addressed in this article is whether analysts shall consider patents as monopolies or as competitive properties. This is an important question for (i) industrialists, investors and venture capitalists, and policy makers. As mentioned in the introduction, there now seems to be a consensus in the mainstream law and economics literature that there is no ground for assuming that patents confer monopolies, and that, if they do, this will in fact be only under rare conditions. Such conclusions do not provide any serious worries for the tightening, and increased enforcement, of the patent system that we are currently experiencing in the global economy.

However, in this article I support the view that patents *in principle* are competitive properties (as defined in the law and economics agenda of exclusive rights), but, based upon my evolutionary economics scholarly upbringing, I disagree with the mainstream view that patents very rarely confer monopolies *in practice*. Basically, I argue that the mainstream law and economics literature has over-emphasized the importance of *direct* blocking power of patents in physical product markets (which there might be some of, but not tremendous), while they have ignored a range of effects or variables that are important to factors shaping the behaviour and functioning of the patent system into monopolistic conditions.

The factor substitution problem when patent protected blueprints become embedded and localized: On of the most important effects or variables that have been overlooked in the literature arguing that patents do not confer product monopolies include a true understanding of the problem of technology markets, where factor substitution regarding patent protected blueprints is not an option. That is, there is a difference between the blueprint nature of patents and patent markets, on the one hand, and the particularistic and localized nature of the technology in which the blueprint is invested and applied or embedded, on the other hand. Whereas the private element of the blueprint in the former is enforced by legal rights, the private element of the technology in the latter is *truly private*, as it cannot even be traded. In other words, the mainstream law and economics literature neglects the path-dependent nature of the co-evolution of a blueprint (i.e. patent protected idea) with products and process innovations. It is exactly this feature that makes the patent holder so powerful, and this is especially true over time where competencies in applying and capturing rent from the patent protected blue-print have become more specialized (although stronger) and sunk-costs are higher.

Complex products and complex systems does not reduce, but increase, the power of patents: A central argument in the paper was also that increased product complexity does not reduce the power of each patent holder, as suggested by the mainstream patent literature. Rather, it may in fact be a feature that gives the patent more monopolistic power, as in such a situation a firm has invested its resources in a complex bundle of cross-applied patent protected ideas. In this case, the firm is locked into a

whole technological web (or technological system), and the more technological ties in which the firm has invested its resources, the more expensive it is to substitute the technological components and sub-components with different technologies (or blueprints). The mainstream law and economics literature has over-emphasized the role of the one-to-one mapping of technologies and products when aiming to analyse the monopolistic power of patents. Moreover, when determining the monopolistic power of a patent, the mainstream law and economics literature has mistaken the specific role of the overall technological systems and techno-economic paradigm into which businesses and societies are locked into.

The production function is historical rooted and reflects a past society: Furthermore, the mainstream lawyers and economists have a very awkward treatment of patents as only an input variable in the mainstream production function, whereas output (or a product) is something else (i.e. value added here is something physical by definition). This is based upon the physiocratic physical notion of the production function. The implications for this is that the mainstream lawyers and economists do not treat patents as being able to confer direct monopolies in the markets in which they are traded, but their market effects can only be accounted for when they are embedded in a physical product. This awkward treatment of patents as only an input variable in the mainstream production function is a serious analytical problem when understanding the direct monopoly effects of patents.

Complex market structure of patents rights and different conducts for rent generation are important stylised facts that need to be integrated in market analysis: The complexity of the different market structures of patents including the complexity of ownerships and licensing agreements has not been integrated into the mainstream law and economics analytical frameworks. This has indeed implications for different combinations of quantity and price for patents and thereby the look and shape of the market demand curve for patents.

Corporate strategic interaction is important to understand the effects of patents: The role of corporate strategic interaction in patent markets, and the effect this may have on creating monopoly situations, has largely been ignored or underestimated in the mainstream literature.

***Pricing, costs and incentives:* At last, this article confronts and challenges the mainstream arguments defending the price setting above marginal costs of production. The mainstream arguments are related to supply side cost-arguments and incentive to invent arguments. Conversely, I argue in this article that, because existing analytical frameworks do not encapsulate all the costs or complexities associated with the patent trading system, this not-transparency does not justify up-marking of price or can serve as any evidence of that there is not a monopolistic situation. Rather, it simply calls for the development of better analytical frameworks for analysis. Moreover, the patent system is a mixed blessing, as it does lead to the creation certain social costs, and many of those are largely ignored in the mainstream literature.**

On all the grounds listed above, I believe that these are the reasons why the mainstream law and economics literature fails to recognize how monopolies from patents so easily can occur, and how social costs from patents can persist over time.

Finally, I do not believe that the 'competitive property right' versus 'monopoly privilege' question of the patent system can, or should, only be confronted on the grounds on the whether a patent is beneficial or creates social costs. We need more insight regarding the most appropriate design of the patent system when addressing the 'rights' versus 'monopoly' question. 'What type' and 'how much' exclusive rights should the system confer? Design includes issues like: (i) length of protection obtained,

(ii) type of knowledge protected (e.g. should basic procedures to obtain DNA codes; some mathematics; not technical business methods be protected; etc), (iii) scope of knowledge protected (allowing or encouraging protection of basic ideas in university laboratories or not), licensing law (opportunity to block or compulsory licensing), (iv) costs and procedures of obtaining and holding a right, (v) type and costs of the remedies available for infringement, etc.

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