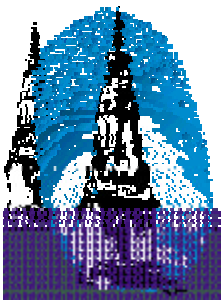
LEFIC
Copenhagen Business School
Solbjerg Plads 3
DK-2000 Frederiksberg

Center for Law, Economics and Financial Institutions at CBS



LEFIC WORKING PAPER 2003-05

On the Macroeconomic Effects of Establishing Tradability in Weak Property Rights

Gunnar Eliasson
&
Clas Wihlborg

www.cbs.dk/LEFIC

2003/09/01

On The Macroeconomic Effects of Establishing Tradability in Weak Property Rights[1]

by
Gunnar Eliasson, KTH (Royal Technical University), 10044 Stockholm, Sweden
Fax: +46 8622 6914
and
Clas Wihlborg, CBS (Copenhagen Business School), Copenhagen, Denmark
E-mail: cw.fi@cbs.dk; fax: +45 3815 3600

Abstract

The New Economy is closely associated with computing & communications technology, notably the Internet. We discuss property rights to, and trade in, the difficult-to-define intangible assets increasingly dominating the New Economy, and the possibility of under-investment in these assets. For a realistic analysis we introduce a Schumpeterian market environment (the *experimentally organized economy*). *Weak property rights* prevail when the rights to *access, use,* and *trade in* intangible assets cannot be fully exercised. The trade-off between the benefits of open access on the Internet, and the incentive effects of strengthened property rights, depend both on the particular strategy a firm employs to secure property rights, and the protection offered by law. *Economic* property rights can be strengthened if the originator can find innovative ways to charge for the intangible assets. The extreme complexity of the New Economy and the large number of possible innovative private contract arrangements make it more important to facilitate the use and enforcement of private individualized contracts to protect intellectual property than to rely only on standard mandatory patent and copyright law. *Enabling law* is one proposed solution. Current patent legislation in the US has led to costly litigation processes weakening the position of small firms and individuals in patent disputes. The property rights of such firms and individuals could be strengthened with insurance or arbitration procedures.

Key words: Competence bloc theory, Enabling law, Experimentally Organized Economy, New Economy, Weak property rights, Tradability, Underinvestment.

JEL Code: D21, D23, D52, D82, H54, K11, K22, K41, L11, L23, M13, O14, O33.

[1] An earlier version of this paper was presented at the 9th Congress of the International Joseph A. Schumpeter Society (ISS), Gainesville, Florida, USA, March 28-30, 2002.
The paper is part of the large *Nödfor* project on Schumpeterian Creative Destruction, notably the exit and bankruptcy process, based at the *Ratio Institute,* Stockholm

I Introduction

The existence of markets depends on the establishment of property rights. The reallocation of property rights through trade is central to the capacity of the economy to enhance economic welfare. Since at least Arrow (1962), we have had an academic debate on a presumed under-investment in knowledge and information assets with high social, relative to private, returns. Under-investment has been linked to a possible lack of incentives and badly-defined property rights (Kremer 1997). Hence, the proper design of, and the support of, property rights should be a major concern of any central authority or Government. North and Thomas (1973) even argue that not until a good institutional foundation (read legislation and conventions supporting property rights) had been laid in Western Europe did the industrial revolution begin, based on technology and knowledge that had accumulated during the previous centuries. Implicit in their argument was that nations that did not get their institutions right, could not benefit from the technology of the industrial revolution, despite a sufficient endowment of technology and production knowledge.

The evolving structures of the New Economy are, to an increasing extent, composed of digital abstractions of intangible assets with difficult-to-define property rights. Although the social value of these assets can be high, and may be enhanced by the Internet, the originators may not be able to charge a price for individuals' access to the assets. The Internet is a "double-edged sword": On the one hand, it enhances the social value of these assets, while on the other hand, it makes them increasingly accessible for potential users and, hence, difficult to charge for. The analysis of difficult-to-define property rights within endogenously-changing structures of intangible assets requires a dynamic, Schumpeterian-type model framework. To that end we introduce the Experimentally Organized Economy (Eliasson 1992) populated by ignorant rather than fully, or marginally, uninformed actors.

The industrial policy debate has often focused on a presumed under-investment in knowledge creation due to a lack of incentives, notably in investments with a high social return. Incentives to do so are, in turn, closely related to the design and enforcement of property rights. Thus, for instance, investment rich in spillovers, but with a low private return, may not be made, even though the social return is very high, because the originator cannot appropriate the value of the spillovers privately (Eliasson 2001b).

Property rights are more or less easily established depending on the type of assets. You can exercise your (property) right to an apple by holding it in your hand, and selling it to your neighbor who knows that it came from your garden. The (property) right to residential property and land is more complicated since it stretches over time. In the distant past this right was upheld by physical presence -- living on the property and defending the lot with weapons. Today such property rights in civilized countries are enforced by elaborate registers and the legal system.

The difficulties of exercising property rights escalate with the degree of abstraction of the assets. The highly abstract rights in securities markets to the future profits from an investment commitment today took a long time to establish (Eliasson 1993). In a very obvious way, the world political system was being overtaken during the last decade of the millennium by trading in financial abstractions (mathematical algorithms) representing property rights guaranteed by the legal systems of nations and, more importantly, by mutual trust between, and conventions among, financial institutions (Eliasson and Taymaz 2002, Eliasson and Wihlborg 1998).

Perhaps the most difficult and perhaps also the most important property right for the New Economy is *intellectual property*. One aspect of the New Economy is the great share of asset values explained by intangible knowledge and information. A second aspect is the technology enabling transfers of information extremely cheaply and rapidly by means of digital abstractions on the Internet.

We argue in this paper that the capacity of nations to establish efficient institutions for property rights to intangible assets will be decisive for the ability of nations successfully to enter the New Economy[2]. Our focus is on the spectrum of more or less *weak property rights* between no right – and no tradability – and completely uncontested rights to intangible assets. Since none of the extremes exist, property rights cannot be regarded as either one or the other, as is conventional practice in the literature. Even when legal rights exist, the economic property rights can be contested and weak. The degree of contestability of *property rights* depends on law, precedent and convention, and especially on the private costs of protecting the rights by various means. Rights of entering contractual arrangements for the use of an intangible asset affect the contestability of property rights. We argue that the costs of a particular way of

[2] See also Eliasson, Johansson and Taymaz 2002, on *Simulating the New Economy*

protecting property rights include lost opportunities as well as outright transaction costs. We question the efficacy of conventional legal approaches to protecting intellectual property rights for the important assets of the New Economy. Contractual arrangements should be supported, however, by enabling law.

In Section II, the concepts of the macroeconomic setting are described as an ”experimentally organized” economy, wherein ”competence blocs” play an important role. The importance of intangible assets is emphasized. In Section III, we focus on the link between intellectual property and economic growth. Section IV reviews the literature on the efficiency of patent protection, and we argue that the ”under-investment” literature does not capture important characteristics of intellectual property in the New Economy. The transactions costs approach to property rights is reviewed in Section V. We borrow the idea of redefining transaction costs to include the costs of business mistakes, which are typical of the experimentally organized economy, from the conference companion paper Eliasson – Eliasson (2002a), and derive the implications of this approach for property rights formation in the New Economy, and in competence blocs in particular. The implications of the new digital world and Internet technology for economic property rights and indirectly for economic growth are discussed in Section VI before concluding in Section VII.

II Intangible Assets, Their Valuation and the Experimentally Organized Economy

The valuation of, and trading in, intangible assets in an experimentally organized economy featuring frequent business mistakes are studied from a property rights and efficiency perspective, using competence bloc theory.

II.1 Valuing assets

It was, and still is, almost a dictum within the accounting profession that the measurement of intangible assets is a hopeless, arbitrary task. However, some three decades ago the economics profession was entrenched in an intellectual conflict called the capital controversy (see for instance Robinson 1964, Solow 1963). The winning side concluded that capital in general (physical or not) as a factor of production was theoretically *unmeasurable*, since its value

could not be theoretically separated from its return. A more meaningful approach, however, would be to say: *yes* of course, but there are still methods of estimating capital or asset values that can serve as useful approximations in many contexts if one knows what one is doing. Our main argument, however, is that there is no principal difference between measuring physical and intangible capital, only a matter of degree in difficulty, and perhaps not even that.[3] For instance, financial derivates and similar financial instruments are highly intangible and abstract. They are constantly valued and traded in markets and are probably more concrete and definable than many physical capital items. Most of these instruments are not patented, although since the early 1970s new financial instruments (”mathematical algorithms”) have been patentable in the US. This patentability was unambiguously established in 1998 when the new (since 1982) Court of Appeals for the Federal Circuit (CAFC) upheld a patent on a software system in a law suit between Signature Financial Group and State Street Bank.[4] [5]

For our future discussion, let us distinguish between hardware, intangible and entrepreneurial assets (capital)[6] as in Table 1 (see Eliasson 2000a). Subtracting debt from the sum of the three capital items, we obtain an extended definition of net worth, as it is continuously valued and traded in the stock market.

(Table 1 in about here)

The value of a firm is to a large extent embodied in people, or teams of people with tacit competencies representing ”entrepreneurial competence”. Entrepreneurial teams dominate the fate of large and small firms alike (Eliasson 1990a), but the individuals are always free to leave the teams within the limits of their contractual obligations. This mobility creates a valuation problem, since the mobile entrepreneurial competence affects the value of most of the assets on the balance sheet of a firm.

[3] See Kingston (2002).

[4] The interesting thing is rather that the academics who had come up with the algorithms rarely patented them, signaling a great unawareness of the commercial opportunities of what they are doing in their research (see Lerner 2000c).

[5] This decision explicitly rejected the notion that ”business methods” were inherently non patentable.

[6] Entrepreneurial capital is intangible but also tacit and generally not codifiable.

One problem with the mainstream neoclassical model is that capital is assumed to be computable by the conventional present value formula[7], and no attention is being paid to the competence of actors in financial markets in pricing the assets they value. It is assumed that neither firm management nor stock market analysts and traders make mistakes that influence the long-term growth outcomes except for stochastic mistakes around the exogenous equilibrium trajectory. The producer, the innovator, the entrepreneur and the (venture) capitalist are all aggregated into one actor in the neoclassical model, and this one actor is assumed to be more or less predictable and calculable, barring a stochastic term.

We argue that the valuation of, and the capacity to, trade in claims on a firm depend on the actors in financial markets, who must *understand the role in production of the three categories of capital* (Eliasson 1990a,2003). For this we need an Austrian/Schumpeterian (1911) type model in which business mistakes become a normal, non-stochastic phenomenon and failure through exit a frequent consequence.

II.2 The experimentally organized economy – the growth connection

By far the most important prior assumption of economic analysis – often without prior comment – concerns the limited size and complexity of the models' state space. We prefer to call this space the investment *opportunities space*. This assumption on the size of the opportunity space is decisive for the state of information that can theoretically exist in the economy, and for understanding the existence and nature of markets and the dynamics of economic growth.

By expanding state space (by assumption) far beyond the limits allowed in the models of New Growth Theory and the models of asymmetrically informed markets of the Akerlof – Spence – Stiglitz type (ASS), it has been demonstrated that growth occurs through the four categories of *selection* or Schumpeterian creative destruction in Table 2 (see Eliasson 1996a, 2001a). Among the four categories -- entry, reorganization, rationalization and exit -- the last one, involving the positive role of frequent business failure, will play a particularly important role in our growth analysis.

[7] Recent developments in corporate finance have undermined the discounted cash flow model by introducing "real options". In particular, "growth options" based on firms' intangible assets and entrepreneurial capital are viewed as a major share of firms' values in the New Economy.

Three circumstances of importance for our further discourse should now be observed. *First*, the creation and selection dynamics of the Schumpeterian creative destruction process of Table 2 does not automatically lead to growth. If competence and incentives are lacking, incumbent firms may contract and exit rather than invest and expand. *Second*, the Schumpeterian creative destruction process of Table 2 can be seen as a dynamic allocation scheme dominated by selection, i.e. creation through entry and failure through exit. The creation side must also be supported by competence, notably by the ability to create and to discover winners and carry them on through the competence bloc of Table 3B to industrial scale production. Losers must be driven out of business through competition and exit (item 4 in Table 2). *Third*, the smooth functioning of this creative destruction process, being supported by entrepreneurial and venture capital competence, requires the support of an appropriate infrastructure of institutions. This is where property rights enter to establish tradability in the knowledge or competence categories that rule the allocation process

(Tables 2 and 3A, B in about here)

II.3 Competence bloc theory – innovative creation and competitive selection

With economic dynamics and growth being dominated by experimental selection, the efficiency of that selection becomes important. One aspect of efficiency is defined by the minimization of the economic consequences of the two types of business mistakes of Table 3A; keeping losers on the budget for too long and losing the winners. Competence bloc theory explains the way in which this happens.

The competence bloc (Table 3B) lists the minimum number of actors/individuals with competence needed to create, to identify and to carry winners on to industrial scale production and distribution.

For such a successful and industrially dynamic outcome, the competence bloc has to be *vertically complete* and exhibit great *horizontal variety*, thereby reaching the *critical mass* needed to guarantee potential winners' increasing returns to the continued search for resources (see Eliasson and Eliasson 1996, Eliasson 2001(a). A competence bloc typically includes several types of entrepreneurial capital. For didactic purposes, one can observe that a large firm may internalize most, or all the competence functions of the competence bloc in one hierarchy, thereby merging the innovative, entrepreneurial, venture capital and industrialist functions into one aggregate, which is typical in neoclassical production analysis. IBM in fact

did this in its heyday during the 1980s; it was even an advanced customer to itself (Eliasson 1996a, pp. 175 ff). Alternatively, the competence bloc allows typical business functions to be distributed over the market where different types of competence are applied and allocated in a decentralized manner. It is argued in Eliasson and Eliasson (2002a) that decentralized competence blocs maximize the exposure of each project to a competent and varied evaluation and minimize the risk of losing a winner. The competence bloc solution has to be supported by economic property rights that allow trading in intangible competence capital over markets such that prices are correctly set for an efficient outcome. We return to this issue below.

III. Intellectual Property and Economic Growth

Economic growth occurs through the innovative creation and competitive selection of projects at all levels of aggregation as projects are filtered and allocated through the competence bloc (Tables 3) and introduced in the economy as new entries of ideas, projects or entire firms. The process forces reorganization and change among incumbents, and it forces some actors to exit (see Table 2). Eliasson and Taymaz (2000, and 2002) demonstrate in a micro to macro model framework that a healthy exit process is critical for sustainable growth.

The endogenous Schumpeterian creative destruction process could be more or less efficient in two ways. *First*, the creation and selection process in Table 2 can be more or less efficient in terms of minimizing the costs of the two business errors noted in Table 3A. In particular, losing winners as a result of deficient (vertically incomplete and/or horizontally narrow) competence blocs is costly. *Second*, even if the competence exists, incentives to innovate may be lacking due to a deficient property rights design and a weak capacity to reallocate industrially valuable knowledge or competence through trade. Both factors would contribute to an under-investment in innovative activity, even though the benchmark of what is best possible is realistically unclear in the experimentally organized economy, in contrast to being precisely and misleadingly well-defined in mainstream analysis.

A country's relative productivity depends on its capacity to absorb technology, observes Eaton and Kortum (1995). Eliasson (1990a) denotes this capacity *receiver competence*. Except for the US, continues Eaton and Kortum, OECD countries derive almost all of their productivity growth from abroad. However, they also argue that countries still earn most of their returns to

innovation at home, while foreign countries are important sources of technology (Eaton and Kortum 1994).

These references represent indirect evidence that (international) *trade in industrial knowledge* matters. The trade can take many forms, however, depending on the design and protection of property rights to knowledge. Since there is ample evidence that new technology stimulates growth, it is deficient tradability in knowledge that might lead to under-investment in innovative activity, less than efficient allocation of knowledge capital, and less growth than is potentially possible. Direct evidence in the economic literature on the growth effects of *legal* property rights systems is weak, however. Lanjouw, Pakes and Putnam (1996) point out that patent counts are imperfect measures of innovative output (read R&D). They then go on to adjust raw patent data for their value to the holder to derive a better measure of such output[8]. They also show that the economic value of the patent depends on the legal rules of patent protection. Aoki and Prusa (1995) observed that the Japanese patent system has allowed rival firms to look at the application. In the US the information is not available until the patent has been granted.[9] This implies, according to Aoki and Prusa, that Japanese rival firms have had an information advantage when they planned and coordinated their R&D efforts, which in turn should have led to smaller but more frequent quality improvements. Sakakibara and Branstetter (1999), however, found that the broadening of the scope of patent protection in Japan 1988 did not produce a significant positive change in innovative output in Japan.

The macro connection is invariably reached through an imposed equilibrium path, a method established innovatively in the Jorgenson and Griliches (1967) article, and returned to theory under the name of New Growth theory by *inter alia* Romer (1986). The positive macro growth effects in these models depend critically on strong positive spillovers in innovative production feeding into investment and output through conventional neoclassical production function analysis.

New Growth models predict that expansion in innovative outputs leads to a permanent increase in total factor productivity growth. This, however, may not be empirically correct, argues

[8] Cf. The method used by Jorgenson and Griliches 1967, not quoted.

[9] Since November 2000 patent applications in the US are disclosed 18 months after having been filed (Johnson and Popp 2001).

Porter and Stern (2000). Empirical evidence rather suggests "that most OECD economies have increased the size of their R&D workforce while experiencing (at best) constant total factor productivity growth rates". They go on to explain the role of "ideas production" in economic growth using patent stocks to estimate the strength of spillovers from ideas–to–ideas, and find a small (but significant) effect of patent stocks on the level of total factor productivity, concluding that (op.cit., p. 27) "ideas-driven growth may be feasible. However, the size of such effects may be modest".[10]

Porter and Stern (2000) point to other factors such as "the national (or even regional) environment" that may be more important for understanding the dynamics of economic growth. These other dimensions are exactly what we emphasize, namely the dynamics of resource allocation on the micro level, notably of intellectual or competence capital embodied in human beings, systematically excluded by assumption in the macro new growth models. It is, however, explicitly present in the experimental economy/competence bloc approach that was presented above. The importance of tradability in intellectual production capital for efficient allocation of the same intellectual capital stands out. The importance of the micro-to-macro dynamics of such allocation (see Tables 2 and 3B) has been quantitatively demonstrated in Eliasson, Johansson and Taymaz (2002). One insight from this paper is that the processes discussed in Porter and Stern (2000) are very drawn out in time, possibly explaining some of their weak econometric results based on considerably shorter time series data.

IV Property Rights and Efficiency: The Applicability of the Literature on Intellectual Property in the New Economy

There are two conflicting views on the role of patent rights in creating economic value. If patent rights, for instance to intangible assets, cannot be established, incentives to invest in such assets will be low and we have Arrow's (1962) *under-investment* problem. On the other hand, firms will invest resources in the protection of their property (legal or otherwise) and rival firms may

[10] Kortum (1994), using a similar new growth theory model, observes that while R&D employment and TFP have both grown, the rate of productivity growth has remained flat. Eliasson, Johansson and Taymaz (2002) observe, as one of their three paradoxes, that such small effects probably depend on the long gestation periods involved, effects being impossible to identify economically in short time series data. Instead E – J – T simulate the macroeconomic effects of ideas, or technology creation and diffusion on a micro-to-macro model of the Swedish economy using among other things genetic algorithms to model the learning and diffusion processes among firms.

engage in ”wasteful” expenditures or reverse engineering to go around patents. Hence, there could be an *over-investment* problem (Hirschleifer 1971).
Arrow (1962) concluded that competitive markets do not provide supporting incentives for innovative activity, but that patent rights, establishing temporary property (monopoly) rights to an intangible asset (a technology), may not be statically efficient. To make sure that innovative activities take place despite the lack of incentives, these activities should be conducted in publicly-funded laboratories making ”innovations” freely available to everybody. The 1962 article has exercised considerable influence on the debate about patents and the organization of basic research, but Arrow (1962) did not incorporate a number of critical empirical circumstances in his analysis -- the analysis was carried out in a zero transactions cost environment in which all knowledge, once supported by legal rights, was treated as ”tradable” information. In an economic theoretical environment where transactions costs are dominant and exceed 50 percent of all resource use in the economy (Eliasson 1990b), the theoretical conclusions would be entirely different.

Arrow did not consider that the efficiency of innovative activity is critically dependent on its organization, and that the links between the academic laboratories and the industrial introduction of innovations are long, weak and costly[11]. His analysis has led to an overemphasis on academic research as a source of innovations. Basic technology development in academic or firm laboratories only draws a tiny fraction of the resources needed to take new technology to industrial scale production and distribution. Furthermore, technology is not merely information, and building a business on new technology requires considerable competence and resources. The consequence of Arrow’s proposal might even be that no innovations would reach industrial production. Hence, the main transactions cost associated with Arrow’s proposition has to be ”lost winners”, a possibility excluded by assumption in Arrow’s analysis. Taken together, it is easy to reverse the conclusions of Arrow (1962) by one or two minor modifications of its underlying (empirical) assumptions.

Another serious objection to Arrow’s analysis is that it looks at (and this is unavoidable in static equilibrium analysis) the innovation as a well-defined optimum solution. In the experimentally organized economy (EOE), there are no well-defined innovations, and above all

[11] Under Arrow’s (1962) assumptions the business idea of Karo Bio (case in Eliasson – Eliasson 2002a, this conference) would have no empirical foundation.

no determinate best innovations. Above all there is no fixed (fix point) reference for efficiency comparisons. Attempts to invent around patents in the EOE (called waste in the Arrow model) may be as innovative, and lead to as unique inventions as the original innovation. In the context of the EOE and Austrian/Schumpeterian analysis, waste becomes undefined and as much an act of learning and renewed innovation as the original invention. R&D subsidies would not improve upon the situation even though the social planner can now exercise his influence (Kremer 1997). The evidence is overwhelming that subsidized industrial research, especially research carried out in special government-operated laboratories, is inefficient, does not turn out winners and leads to low social returns compared to private research which is rich in spillovers [12].

There is another dimension to property rights, which is always disregarded in perfect competition analysis, namely the dynamics of the *allocation* of knowledge or new technology over the actors within the competence bloc. Private economic property rights confer *tradability* to the asset, which can now be sold to another owner who is more competent than the innovator to build a business on the technology. The stronger the property rights the more tradable the asset and the more dynamically efficient the allocation of knowledge or competence. Vice versa, if property rights are weakened, tradability is lowered and economic value destroyed. This aspect of tradability becomes particularly important when tacit knowledge is being considered. Tacit knowledge is embodied in human beings or groups of human beings and is typically reallocated through trade in the markets for executive competence and strategic acquisitions.

An alternative to the proposed research subsidies would be *patent buy-outs* (Kremer 1997), especially when based on auction pricing. One advantage of *patent buy-outs* is that they can be more naturally placed in the environment of the EOE as long as research results can be codified. In order not to kill incentives, the buy-out should not be at a lower price than the private value. To elicit the private value, an *auction* could be used, and to avoid private rigging of the auction, sealed bids should be used. Kremer (1997) suggests that the Government should offer the private value (the auction price) plus a mark up to cover the social value and that the

[12] (See Eliasson 1996b and 1997a) In addition, big companies invested in large central corporate laboratories during the 1970s and 1980s, on the assumption that they would churn out new basic technology. The results were not positive (Eliasson – Granstrand 1985) and firms, in contrast to Governments, have been fast to close down such facilities.

patent holder should always have the right to reject the offer. Since the social value of research is normally much higher than the private value, governments should offer much more to stimulate inventions with a high social value. Kremer (1997 p. 17) suggests that the latter is at least twice the estimated private value. If the inventor refuses to sell, for instance because of a strong information advantage, the system of patent buy-outs functions like the current patent system.[13] Shavell and van Ypersale (1999) in fact argue that ”intellectual property rights do not possess a fundamental social advantage over reward systems”.

It seems that the empirical literature on patent protection and efficiency comes out only hesitantly in favor of patents[14]. The reason appears to be a lingering negative attitude, or an ideological aversion, towards creating and protecting private (even though temporary) profits. Lerner (2000a) concludes from his 150 year survey of patent office practice that ”Nations where information asymmetries between government officials and patentees are likely to be more prevalent – larger countries, wealthier economies, and those where international trade is more important – incorporate discretionary features into their patent systems more frequently” and ”divide the responsibility for determining patentability between the patent officer and the courts when information problems are likely to be severe”. ”Wealthier countries”, he continues (Lerner 2000b) ”are more likely to have patent systems”, but ”they are also likely to charge higher fees and limit patent protection”. ”The origin of a country’s commercial law appears particularly important” in explaining how patent protection is decided, notably in terms of awarding privileges and providing for discriminatory provisions.

Lanjouw and Cockburn (2000) use the fact that much of the developing world has introduced patent protection for new substances developed by the pharmaceutical industry during the 1980s to investigate the incentive effects; and find ”some, although limited, evidence” that more research has been allocated to products ”specific to developing country markets”. [15]

[13] Kremer (1997) presents an interesting case from pharmaceutical industry.

[14] See Cohen – Nelson – Walsh (2000, p. 2) and also Kremer (1997).

[15] The results are based on ”Indian Survey data, and interviews with industry”.

Hall, Jaffe and Trajtenberg (2000) find that the stock market values of companies correlate strongly positively with their stock of patents, notably when they use "weighted patent stocks[16] as an explanatory variable. Many researchers have been surprised to observe that US manufacturing firms in most industries seem to rely more heavily on secrecy and lead time to recoup their R&D investments than on patents. Despite the increasingly "pro-patent" legal environment in the US since the beginning of the 1980s, patents as a means of appropriating R&D returns appear to have declined (see for instance Cohen, Nelson and Walsh 2000). Despite this reported decline in effectiveness of patent protection, an unprecedented surge in US patent applications occurred at the same time (Kortum and Lerner 1997), notably in semiconductor technologies, where patent protection effectiveness has been reported to be particularly low. Hall and Ham (1999) conclude, from a study on the US semiconductor industry over the period 1980-1994, that we can understand this "patent paradox" if we give up thinking in terms of the simple "innovation" or "patent race" model, and instead reason in terms of complex "patent portfolios", involving the many parties and many technologies and complex contracts needed both to design and produce modern complex products and to safeguard and appropriate their value. This resolves "the patent paradox". US semiconductor manufacturing firms, indeed, patent aggressively, since the "pro-patent" legal environment was established in the US in 1982 -- more to raise the positive signals to attract venture capital and to secure proprietary rights in niche product markets than to protect and be able to license particular technologies.

The pharmaceutical and biotech industries appears to be the exception everybody refers to where patent protection is needed (Kremer 1997, pp. 46f), because once the substance formula has been discovered, most of the innovation costs have been expended and replication is easy. Here, however, exceptions are found. Zucker, Darby, Brewer and Peng (1995) observe that intellectual capital in biotech often rests on tacit hands-on-experience that cannot be commercialized as information to outsiders, except by knowledgeable people moving to a competitor. "Natural excludability" can be organized within closely-knit groups of collaborators who share the rents. There is an academic dilemma, however. If the important hands-on-experience cannot be communicated in coded form, academic control through repeat experiments based on published material becomes impossible. Thus, academic peers will have

[16] "References" or "citations" in patents identify earlier inventions whose claims are close to the citing patent. "Citations received" are often used to measure the "generality" of the patent (Jaffe – Fogarty – Banks 1997).

to do with checking the result (”the substance”) without understanding *how* the research team got it out of the test tubes. Alternatively, if the process can be completely and exactly coded for publication, it must be the case that the biotech industry and academics have come up with a rule system that allows the researcher to withhold temporarily critical process information from publication.

Protection of knowledge is more difficult to handle when the knowledge derives from the contractual cohesion of teams that make up the technological and entrepreneurial competence that is decisive for the market value of the firm. If the team breaks up, the value collapses. Darby, Liu and Zucker (1999) use an option-pricing based technique to value the intangible assets defined by the ties to star scientists in biotech firms. They then compare values with the market valuation of the same firms. The underlying hypothesis is that the more ties among stars, the greater the probability that a firm makes a commercially valuable R&D breakthrough. This hypothesis is supported empirically. In fact, the value of a firm, they estimate, increases with 7.3 percent or 16 millions in 1984 dollars with one article written by a participating star scientist.

On the whole, the empirical results imply that when patent protection of property can be well defined it is effective and not very costly to obtain and to enforce. Firms then patent, and are significantly more protected from imitation than they would otherwise be. This situation, however, is not the general one and it changes radically when we consider intellectual property, notably entrepreneurial assets (see Table 1) and the technologies of the New Economy. The variability and complexity of the innovative technology to be protected increase dramatically in the New Economy, as do the possibilities to protect through innovative designs, contracts and organizations going beyond standard patent and copyright law.

V. Economic and Legal Property Rights in Economic Dynamics

In this section, we review the transactions costs approach to property rights and apply it to competence blocs. The costs of business mistakes listed in Table 3A must be considered when assessing the efficiency of a system of property rights. We also argue that, in the New Economy, a legal system using standard, mandatory contracts for various contractual relations is not the most efficient way to protect the extremely varied assortment of entrepreneurial assets. Instead,

the decentralized competence bloc must be based on the variety of contractual arrangements that the experimentally organized economy demands.

V.1 The transactions costs approach to property rights

To go further in the analysis of property rights to the assets of the New Economy, we follow Barzel (1997) and distinguish between *economic* and *legal* property rights. *Economic property rights* correspond to the ability of an agent to capture the present value of the cash flows the asset is expected to generate, while legal rights are those specified in law. Agents can be expected to maximize the value of economic rights by *appropriating cash flows net of transaction costs* one way or the other. Transactions costs can take a variety of forms associated with the protection of cash flows including direct costs, and the potential opportunity costs of the inability to enter into contracts and to initiate activities that could generate cash flows. Appropriation of cash flows, and thereby the creation of economic property rights, take many different forms, ranging from selling the asset, selling products incorporating the asset's services, selling products and services linked to the asset such as TV and Internet advertising, to the merging of firms controlling different assets that can be combined to create conditions for the appropriation of cash flows.

Imperfect or weak economic property rights imply that part of the potential cash flows from an asset are in the "public domain", in Barzel's words. Other agents then have an incentive to appropriate cash flows generated by the asset. Transactions costs arise in this competition for cash flows in the public domain, as well as in attempts to retain appropriability.

The extent to which economic property rights can be appropriated and thereby remain in the "private domain" of the individual generating or holding an asset depends naturally on legal rights to property but also on the ability of the asset holder to utilize the resource as he sees fit. Restrictions on the rights to manage the resource in various activities affect the division of the economic value of the resource into the private and public domains. A great variety of legal rights and obligations affects this division.

If economic property rights were perfect, so that all cash flows potentially generated by an asset could be appropriated and placed in the private domain at zero transactions cost, then

private incentives and social objectives would be aligned. The value of externalities would then be appropriated as well. This proposition follows from the Coase theorem. If there are costs associated with appropriation, then the economic policy problem is more complex. Benefits and costs associated with the creation of economic property rights to any asset with a social value must include the opportunity costs of not creating such rights. A common example is that it would be very costly to define rights to the air we breathe, while if we do not, then non-smokers face costs of drifting smoke, or vice versa. *In* a *world with transaction costs to establish economic property rights, there is no clear reference point for economic policy but rather there is always* a *trade off between different kinds of transactions' costs and benefits*. It is particularly important to consider that any particular way of establishing economic property rights implies that there will be missed opportunities that are hard to identify.

As noted, the appropriation of knowledge-and information assets is particularly costly for well-known reasons. Several types of costs are associated with appropriation or lack thereof. For example, the value of information cannot often be extracted in the market for the information per se, because a potential buyer cannot assess the value without obtaining the information. Another type of cost exists because the value of knowledge is often enhanced by so-called network effects creating scale economies and potential "natural monopolies". On the other hand, anti-trust legislation would then have opportunity costs in terms of lost economies of scale. Also, the value of a particular kind of knowledge depends on what other types of knowledge it can "join" in the production process for goods and services, and on the available expertise with an ability to utilize the knowledge.

An advantage of a competence bloc is that the varied competences within the bloc increase the likelihood that someone will be able to understand the potential economic value of a particular kind of knowledge or information. The bloc is also more likely to contain the entrepreneurial capital required to organize economic activities in such a way that the private domain of the value of the asset is maximized. Hence, in a complete and varied competence bloc, the risk of losing winners is "minimized" and losers are more likely to be weeded out rapidly.

The theory of the Experimentally Organized Economy (EOE) makes the economic value of business mistakes explicit. The mainstream economic model, focusing on the net present values of assets under the assumption that the opportunity sets for uses of assets are known, cannot

account for such mistakes. In the EOE, the opportunity set is itself determined by, for example, the system of property rights and the organization of activities in hierarchies or in decentralized markets. The frequency and magnitude of business mistakes within a certain property rights system for asset should be recognized as a cost of that system. Eliasson and Eliasson (2002 a and b) argue that business mistakes are more costly in a hierarchically organized competence bloc than within a decentralized competence bloc where there are many independent, experimenting entrepreneurs controlling different assets. Also, learning from business mistakes is more rapid in a decentralized bloc. An additional efficiency issue to be discussed is how economic property rights to intangible assets are protected in competence blocs.

V.2 Enhancing economic value through the legal system

Economic rights to intellectual property can be enhanced either by the strengthening of legal property rights or by entrepreneurs and firms organizing their activities in such a way that a minimum of cash flows potentially generated by an asset goes into the public domain. The most well-known legal property rights are created by patent, copyright, and trade mark legislation. The strength of the rights created by this legislation depends on enforcement by the courts and also on the information contained in the creation of patents. Once a firm has applied for patent protection, the application is in the public domain. Competitors then may obtain potentially valuable information that may enable them to develop close substitutes or give them time strategically to reorganize their business. For this reason, certain types of knowledge and technology are not patented.

The empirical evidence reviewed in the previous section indicates that substantial benefits of patent protection are limited to specific industries: in particular, to those using knowledge to produce output with designs that can be easily imitated after observation of the product or service. Even such knowledge can be protected to some extent by the original producer’s first comer advantage, and the protection can be prolonged by brand name reputation. Most knowledge and information being used as an input in the production of goods and services is not that easily accessible. Exclusivity in the supply of know-how may exist, because the know-how itself is not sufficient to put it to use. It is understood that observable product know-how must be combined with some unobservable knowledge or any privately held asset.

It is by no means obvious that strong legal property rights are superior to private methods for enhancing economic rights[17] to intangible intellectual property, even if codified. There are transactions costs associated with the enforcement of legal rights in the form of direct costs of enforcement, and a loss of value when a patent application is made public. Costs of monopoly power created by patent or copyright protection must also be considered. An important transactions cost of enforceable legal property rights can be the disincentive for potential competitors to invest in the development of competing technology. Because of this, the under-investment problem can actually be made more severe. Furthermore, if trade in the patented knowledge cannot occur, the monopoly owner of knowledge assets may not employ it as productively as a competitor would have.

Private contractual arrangements can contribute substantially to the creation of economic property rights even if legal property rights are not explicitly, or are only weakly, protected in law. The extent to which an intangible asset's value lies in the private versus public domain depends on the ability of the asset holder to retain exclusive control over cash flow generated by the asset. Contractual agreements between an asset holder and a buyer of the asset (or the services provided by it) can be used to appropriate the value of the asset when the information contained in the asset can be kept exclusive. For example, the generator of a particular kind of know-how can supply this know-how to someone else while specifying restrictions on the use and resale of the know-how. It is quite common with patented knowledge that license agreements are made specifying restrictions on the licensee's use of the knowledge, but contracts can be entered into without patents. The role of the formal patent in such cases is to provide proof of origin of a technology and the exact delineation of the property being licensed. The existence of the patent may reduce the complexity of the contract and serve a function similar to the registration of real estate. The advantage of the patent in this case must be weighed against the disadvantages mentioned above.

There are two factors limiting the contractual arrangement for the transfer of information and codified knowledge. One factor is that the value of the information may not be easily assessed by a potential buyer without it being revealed. The second factor is that the enforcement of a contract requires that leakage of information to a third party can be traced to its source. We

[17] See Davis (2002a) and Jonasson (2001 and 2002) on "innovative pricing" for a discussion of corporate strategies aimed at appropriating cash flows. Reichman (2001) discusses "Repackaging Rights" as a way of

argue in the next section that Internet technology weakens both arguments against private contracting for securing economic property rights to intangible assets.

V.3 Competence blocs and trade in intangibles

Returning to the benefits of competence blocs, it can be argued that a complete and varied bloc, with a variety of generators and users of intangible assets, raises the likelihood that winners of any particular kind generated within the bloc will be identified. If the intangible assets can be traded, then the competence bloc can be organized as a group of firms with different entrepreneurial capital, while if the asset cannot be traded, the competence bloc is more likely to be organized as a large firm with many kinds of entrepreneurial capital "under one hat". Within this firm, the trade in intangibles is "internalized". Most likely the selection of projects will now be more narrow (less innovative) and the risk of losing winners larger as noted above.

When it comes to more complex intangible assets, such as entrepreneurial know-how or other types of capital that are not only intangible but also tacit, and by definition not codified, contractual arrangements become even more important for the appropriation of economic value. In this case, the tacit, intangible, knowledge asset is typically embodied in a person or a group of persons who can appropriate cash flows only through contractual agreements with financiers, employees, and other potential stakeholders in a firm. The greater the contractual freedom of the entrepreneur, the greater is the possibility that the economic value of the know-how can be appropriated. Restrictions on the contractual agreement between an entrepreneur and suppliers of financing in the form of mandatory standard form formulations of contracts in law can reduce the value of the entrepreneurial capital. In other words, it is desirable that law be enabling with respect to the contractual arrangements among stakeholders (Wihlborg 1998a,b).[18]

Competence blocs in the experimentally organized economy make it possible to combine two or more kinds of tacit, intangible entrepreneurial competences to create new ventures. The most productive form of such ventures may be joint ventures, strategic alliances or outright mergers of firms (Eliasson and Eliasson 2002a). The greater the potential variety of possible contractual

---

establishing economic property rights."

[18] See Kingston (2002) for a practical contribution to valuation of intellectual property. Valuation with some degree of precision is one aspect of tradeability.

arrangements between those possessing the entrepreneurial assets, the greater the likelihood that the most productive forms of cooperation can be found through experimentation. Mandatory standard form contracts for alliances and joint ventures may reduce the ability of one or both entrepreneurs to appropriate values. Standard form contracts that are enabling in the sense that parties can deviate from the standard form by mutual agreement reduce the likelihood that winning combinations of knowledge will not become reality.

VI Economic Property Rights and the Social Value of Intellectual Property on the Internet

In this section, we discuss the manner in which Internet technology affects the costs associated with legal property rights and their enforcement. Thereafter, we turn to the protection of economic property rights on the Internet.

Digital products and production in the New Economy are making the property rights to difficult to define intangible assets increasingly important. The Internet is a key technology shifting economic attention towards intangibles and business concerns towards strengthening weak property rights.

The private creator of a positive externality wants to be able to manage, to earn a profit from and to trade in the values he has created, i.e. to claim property rights to them. If the property right cannot be naturally asserted, for instance by holding the apple in your hand, there are two ways to achieve the desired end: (1) legal protection and (2) innovative contractual, organizational or strategic arrangements as discussed by Davis (2002a) and denoted innovative pricing (IP) by Jonasson, (2002). IP is a way to establish *weak property rights* by means of, for example, innovative product and marketing strategy, and is one method of internalizing an externality. Obviously, if IP can be made effective, the existence of external receiver competence raises the value of the spillover to the originator. It may even be in the interest of the latter to invest in raising receiver competence among customers to raise the value of its product to the customer, to be able to charge a higher price (see Eliasson 2001b).

VI.1 Enforcement and litigation costs

The US legal system has expanded its recognition of legal property rights (Davis 2002a), but Europe has not. Thus European firm must rely on IP to a greater extent than must American firms selling in Europe. To the extent European firms do not enter the US market, they could otherwise become free riders on concepts and ideas developed in the US. More likely the costs of expanding legal rights to concepts and ideas will create enormous costs of litigation, since ideas and concepts are often ”in the air” and being formulated in many different places more or less simultaneously. Creating exclusive rights to one among many idea-originators may create substantial costs in terms of restrictions on the use of the ideas.

In assessing the role of legal intellectual property rights, Lanjouw and Lerner (1997), LL below, emphasize the costs of enforcement, which appear to be large and increasing in the US in particular. Litigation is a part of, and a significant part of, the expected transactions costs associated with establishing a tradable property right. Enforcement of legal property rights and the associated expected litigation costs are particularly important when it comes to establishing tradable intellectual property rights. In fact, new financial products addressing patent litigation costs have emerged in the market. It is possible to invest in part-ownership in patents solely for the purpose of litigating them. A patent enforcement insurance market also appears to be emerging (Hofman 1995).

The empirical evidence presented by LL for the USA indicates that the broader the patent the more asymmetric is the information between patent holder and patent infringer, and the higher is the probability of litigation. The broader the patent the greater is also the stake of the plaintiff and the more valuable is the patent and the firm holding it. Furthermore, the more revolutionary the patent, the broader is often the patent coverage and the larger is the number of patent citations. The number of patent citations is ”strongly” correlated with the probability of an infringement suit”. Lanjouw and Schankerman (1997) furthermore find that more valuable patents, notably those in new technology areas, are ”more likely to be involved in litigation”.

There is also strong evidence that large firms use their financial leverage to take small firms to court (LL, 1997) and that larger and financially strong firms predate on less financially healthy firms through patent litigation (LL, 1996). Since small firms are significantly more innovative than large firms (see Acs and Audretsch 1988, and Eliasson and Eliasson 2002a), and small

firms seem to be the creative origin of the revolutionary new technology moving the New Economy, this bias in transactions costs may hold back the emergence of a new economy.

An interesting observation in this context is that the probability of being involved in a patent suit is much higher for valuable patents and/or for patents owned by individuals and smaller firms. Patentees with large portfolios of patents to trade, on the other hand, encourage ”cooperative” interaction and avoid court action more successfully (Lanjouw and Schankerman 2001). The bad side, again, is that the smaller the firm holding the patent, the more vulnerable it is. This encourages the large firms to predate on small firms to acquire patents cheaply. Thus, efficient incentives to innovate and to allocate intellectual assets in a property rights system with wide scope as in the US require that small firms and individuals be able to protect themselves against the possibility that they will face large litigation costs.

Kingston (2000) argues that insurance arrangements for the protection of the intellectual property of small firms are not likely to work for reasons of moral hazard. He favors instead arbitration procedures, since disputes are intrinsically technical in nature. Furthermore, the arbitration procedures should be compulsory because voluntary procedures would not be accepted by financially, relatively strong parties. Were this the case, the litigation costs associated with the legal property rights system could be reduced.

A legal system with more narrow legal protection of intellectual property rights would have to rely on contractual, organizational, or strategic approaches (IP) to secure protection of economic property rights. To the extent contractual approaches are used, legal enforcement costs would exist but to a lesser extent if contracts were specifically designed for the parties, and possibly combined with organizational and strategic innovation. Such innovations carry costs themselves, however. An issue is how these costs are affected by the new technology.

VI.2 Realizing the potential value of the Internet through economic property rights

In 1837, Daguerre offered to sell his photography process to a single buyer for 200.000 francs or to 100 to 400 subscribers for 1000 francs each. (See Kremer 1997, pp. 11 ff) Nobody was willing to buy, either because they did not understand the potential of photography and/or found the offer too expensive. Somebody close to the French Government, however, must have understood the economic potential of photography and convinced the French Government to

purchase the patent from Daguerre in 1937 and to make the patent freely available to the world for a lifetime pension offer[19], considerably larger than what Daguerre had tried to elicit from the private market. Privately this patent buy-out may have looked generous. Socially, however, the deal was a winner for the world. In terms of economic insight, it compares extremely favorably and fairly with the deal offered Swedish inventor Håkan Lans by the UN and the large IT-companies in 2001 for his patent on a GPS-based Global Positioning & Communications (GP&C) system. To become a global standard, Håkan Lans had to turn over his patent to the world for free.

These examples illustrate the potentially enormous social values that may flow from intellectual property. The Internet is itself an intellectual innovation with potential social value of magnitudes that cannot be imagined[20]. To realize the potential value, conditions for establishing economic property rights to information on the Internet must be understood and clarified.

The open access of the Internet is the cause of an enormous increase in the general accessibility of information. Much information on the Internet is literally in the public domain by a simple click. From the point of view of property rights, this implies that costly arrangements must be introduced to establish exclusivity of information and thereby to place it in the private domain. Alternatively, appropriation of the economic value of information on the Internet can take place by indirect means --.for example, advertising on a web-site with valuable information, or enhancement of the value of a product supplied separately.

The technology related to the Internet is rapidly developing with potentially important consequences for economic property rights. First, electronic contracting can be expected to become widespread, secure, and enforceable in the near future with the support of courts' acceptance of electronic signatures (Hultmark 1999). Secondly, all activities on the Internet leave an imprint which enables the flow of information to be traced. There are also ways of hiding or obscuring the source of information flows but technology is moving in the direction of

[19] Of 6000 francs per year, corresponding to some $1.8 million in 1988.

[20] Timothy J. Berners-Lee passed up great wealth when he - in 1990- decided not to patent the technology used to create the WWW. A similar problem is coming up with the project on a semantic web in which Berners - Lee is also involved. IBM and Microsoft have proposed installing toll booths on the information highway to allow patented software to be used. Berners-Lee is against such arrangements as are the *Free Software*

greater ability to trace flows from computer to computer[21]. This characteristic of the Internet is already seen as a threat to privacy in many dimensions. The third characteristic of the Internet with potential consequences for property rights is that very tiny pieces of digital information can be identified and potentially transferred exclusively. In combination with electronic contracting and the ability to trace information flows, it should be possible to define economic property rights to very small pieces of information. The limitation to the appropriation of the economic value of tiny pieces of information lies not in the size or magnitude of the information itself, but in the cost of enforcement relative to the economic value of the information. Proposals exist on the Internet for organizing the information flows through a database in such a way that enforcement through tracing can be made very cheap. The database would contain many individuals' small and large pieces of information, and it would enable members of the database to trade in "information assets". Contracts restricting the use of information on the database could be enforced by the organizer of the database.[22].

If economic property rights to tiny pieces of information can be realized, the consequences for both economic activity and privacy can be great. For example, the tracing of flows can now be used by firms to identify preference patterns of consumers. If rights to tiny pieces of information can be enforced, then individuals could claim the economic rights to information about their preferences with respect to products and services, and their specification. If so, they could contract with providers of Internet services that information about their use of the Internet must not be sold. Instead, individuals' preferences would be available at a price, and even very small payments could be made nearly costless on the Internet. On the production side, the ability to trade in tiny pieces of information could have important consequences. Economic rights to a greater range of intangible assets could be defined. Tacit, entrepreneurial capital could be devoted to combine the pieces in new productive ventures. The virtual entrepreneur and the virtual competence blocs may become reality.

VII Conclusions on the Role of Patent and Copyright Protection in Economic Growth

---

Foundation and the *Open Source Initiative* (Business Week , March 4.,2002, pp.83-87).

[21] Windows 2000. Also see Jonasson (2001, ch. 4).

[22] See www.preference.tv

Most or all analyses of patent and copyright protection have been carried out within the constraints of the mainstream imperfect information/asymmetric information model of I/O analysis. We believe that the intellectual constraints of that model bias both the theoretical and the empirical results. We have, therefore, based our analysis on the assumptions of the experimentally organized economy (EOE) in which actors are not marginally uninformed, but rather are grossly ignorant about circumstances critical to their long run survival, and constantly make more or less serious, often fatal business mistakes. Since this model has no fixed (external equilibrium) reference for efficiency or opportunity cost measurements, the definition of transactions costs must consider opportunities for experimentation. To come up with any firm conclusions on the role of patent and copyright protection in supporting the introduction of a possible New Economy we have, therefore, approached the problem in steps.

First, we have introduced the concept of weak property rights and imperfect tradability of (intangible) assets as a normal phenomenon in the Experimentally Organized Economy (section II) and then (*second)* linked that tradability to the efficiency in allocating the same assets to generate economic growth (section III). *Third,* we have assessed the role of patent protection in general in promoting economic growth. This is where the bulk of the literature is to be found (section IV). *Fourth,* we have looked at the particular assets (intellectual property) associated with the Internet and other technologies of the New Economy (section V).
With this, we have addressed the difficult and specific problem of less than perfect (weak) property rights and the less than perfect tradability in the assets that move growth in the New Economy, an aspect of reality that is incompatible with the mainstream model and, therefore, almost completely missing in the literature. The analysis has been conducted in terms of the theory of the Experimentally Organized Economy (EOE) and we are now ready to present the two main conclusions of this essay.

In the EOE, costs of business mistakes, notably lost winners, are potentially very large. This analytical outcome of the theory is consistent with a true endogenization of growth. We apply the theory of competence blocs within the EOE to understand how the costs of such business mistakes can be “minimized”. As a consequence of this redefinition of the benchmark for opportunity cost ”measurements”, the implications of tradability of intangible production capital for dynamically efficient resource allocation change radically relative to the mainstream model. The direct transactions costs of protecting and handling innovations within a hierarchy

are relatively low. The implicit costs of business mistakes, on the other hand, are large. The incidence of business mistakes increases when competence bloc selection is internalized within one hierarchy and opportunity costs escalate when the economic value of the loss of winners (loss in output) are taken into account. A decentralized market based competence bloc increases observable transactions costs compared to those in a narrowly controlled hierarchy (Eliasson-Eliasson 2002a), but reduces the losses of winners. Since the opportunity cost of business mistakes are not recognized in the mainstream imperfect information/asymmetric information model, except as a minor stochastic error term, comparison of the two theoretical models produce radically different theoretical conclusions, the mainstream model favoring central planning by assumption.

Our analysis of the dynamic efficiency of allocation, on the other hand, favors a decentralized, market based system. The efficiency of that decentralized allocation depends on the possibilities of establishing tradability in intangible assets, such that a smooth and competent selection through the competence bloc can be achieved. This first conclusion implies that economic property rights are important, but it does not say much about legal property rights.

Practically all empirical studies on patent and copyright protection have been intellectually formed within the imperfect market/asymmetric information model and have neglected this tradability aspect. A survey of the literature is rather inconclusive with respect to the traditional legal patent protection, indicating that the complexity of reality requires more innovative and varied designs to protect the economic value of intellectual property.

Our analysis, placed in the context of the experimentally organized economy (EOE) and the Computing & Communications technology of the New Economy, adds a new dimension of complexity. The number of possible arrangements to claim economic property rights is very large, as are the number of opportunities of protecting intellectual properties through innovative private designs of contracts, organizations, and product-and marketing strategies. This variation is costly to maintain, but those costs should be seen in the context of the enormous gains that can be captured in the form of lower total transactions costs, and in the form of a smaller loss of winners. The computing and communications technology of the New Economy is adding to that complexity and raising the stakes of the game. Hence, our second conclusion is that economic property rights to, and tradability in tacit competencies are not enhanced through expanded

protection by means of easy access to standardized patent and copyright legislation. Such methods may *lower the degree of variation in the selection process and raise the incidence of business mistakes*. The solution should rather be to facilitate flexible and, in one sense possibly more costly, contractual protection through the market in order to enhance the dynamics of competence blocs. The legal framework must be *enabling* with respect to a variety of contractual arrangements that support economic property rights. Mandatory laws for contractual arrangements should be avoided, and legislation should support arbitration with respect to disputes that are primarily technical in nature.

Obviously, the increased efficiency in the allocation of intangible assets discussed in this paper contributes to diminishing the underinvestment problem as it is discussed in literature. The same improvement in the allocation of intellectual capital also contributes to the solution of a different underinvestment problem not discussed in the literature, namely the capturing of winners that would otherwise have been lost because of weak property rights and low tradability. This is, however, a conclusion that can only be visualized within the domain of the Experimentally Organized Economy.

Table 1. The Complete balance sheet of a firm

\+ (1) Hard ware, financial/visible
\+ (2) Intangible
\+ (3) Entrepreneurial
\- -
– (4) Debt
\- (5) Net worth (= 1+2+3-4)

Source: Eliasson, 2000a; Making Intangibles Visible, in Buiges et al. (2000), Table 3.3, p. 61.

Table 2. Schumpeterian Creative Destruction

1.Innovative entry
enforces (through competition)

2.Reorganization

3.Rationalization

or

4.Exit (shut down)

Source: "Företagens, institutionernas och marknadernas roll i Sverige", Appendix 6 in A. Lindbeck (ed.), *Nya villkor för ekonomi och politik* (SOU 1993:16) and Eliasson (1996a, p. 45).

Table 3A. The dominant selection problem

Error Type I: Losers kept too long

Error Type II: Winners rejected

Source: Eliasson – Eliasson 1996. The Biotechnological Competence Bloc, *Revue d'Economie Industrielle,* 78-4^{0}, Trimestre.

Table 3B. Actors in the competence bloc

1. Competent and active *customers*
2. *Innovators* who integrate technologies in new ways
3. *Entrepreneurs* who identify profitable innovations
4. *Competent venture capitalists* who recognize and finance the entrepreneurs
5. *Exit markets* that facilitate ownership change
6. *Industrialists* who take successful innovations to industrial scale production

Source: Eliasson – Eliasson 1996. The Biotechnological Competence Bloc, *Revue d'Economie Industrielle,* 78-4^{0}, Trimestre.

Bibliography

Acs, Zoltan I. – David B. Audretsch, 1988. Innovation in Small and Large Firms: An Experimental Analysis, *AER,* Vol. 78, pp. 678-690.

Aoki, Reiko – Thomas J. Prusa, 1995. "Product Development and the Timing of Information Disclosure under U.S. and Japanese Patent systems", Working Paper 5063 (March), NBER Working Paper Series, Cambridge, Mass.

Arrow, Kenneth J., 1962b. "Economic Welfare and the Allocation of Resources for Invention". Chapter 7 in R. Nelson (ed.), 1962. *The Rate and Direction of Inventive Activity: Economic and Social Factors*. Princeton: NBER, Princeton University Press, pp. 609-626.

Barzel, Yoram, 1997, *Economic Analysis of Property Rights*, Cambridge University Press

Buigues, Pierre – Alexi Jacquemin – Jean-Francois Marchipoints, 2000. *Competitiveness and the Value of Intangible Assets,* Edvard Elgar, UK and USA.

Carlsson, Bo, ed., 1997. *Technological Systems; Cases, Analyses, Comparisons*.

Boston/Dordrecht/London; Kluwer Academic Publishers.

Coase, R.H., 1937. ”The Nature of the Firm”. *Economica*, IV (13-16) (Nov.), 386-405.

Cohen, Wesley M. – Richard R. Nelson – John P. Walsh, 2000. ”Protecting Their Intellectual Assets; Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or not)”, Working Paper 7552 (February), NBER Working Paper Series, Cambridge, Mass.

Darby, Michael E. – Qiho Liu – Lynne G. Zucker, 1999. ”Stakes and Stars: The Effect of Intellectual Human Capital on the Level and Variability of High-Tech firms’ Market Values”, Working Paper 7201 (June), NBER Working Paper Series, Cambridge, Mass.

Day, Richard H. – Gunnar Eliasson – Clas Wihlborg (eds) 1993. *The Markets for Innovation, Ownership and Control*. Stockholm: IUI and Amsterdam: North-Holland.

Davis, Lee, 2002a, “Patents and the Internet”, LEFIC Working Paper 2002-1, Copenhagen Businesss School and forthcoming in Eliasson, G. and C. Wihlborg, *Law, Economics and Technology of the Internet*, Copenhagen Business School Press

----------**,** 2002b, “Is Appropriability a Problem for Innovations in Digital Information Goods”, LEFIC Working Paper 2002-2, and forthcoming in Eliasson, G. and C. Wihlborg, op.cit.

Eaton, Jonathan – Samuel Kortum 1994. ”International Patenting and Technology Diffusion”, Working Paper 4931 (November), NBER Working Paper Series, Cambridge, Mass.

Eaton, Jonathan – Samuel Kortum 1995. ”Trade in Ideas: Patenting and Productivity in the OECD, Working Paper 5049 (March), NBER Working Paper Series, Cambridge, Mass.

Eliasson, Gunnar, 1990a. The Firm as a Competent Team, *Journal of Economic Behavior and Organization*, 13 (3), 275-298.

--------, 1990b. The Knowledge-Based Information Economy; Chapter I i G. Eliasson, S.Fölster et al., 1990, *The Knowledge Based Information Economy*. Stockholm: IUI.

--------, 1991a. "Financial Institutions in a European Market for Executive Competence”, Chapter 7 in Wihlborg, C., Fratianni, M. and Willet, T.A. (eds.), *Financial Regulation and Monetary Arrangements after 1992*. Amsterdam: Elsevier Science Publishers B.V.

--------, 1992. ”Business Competence, Organizational Learning, and Economic Growth: Establishing the Smith-Schumpeter-Wicksell (SSW) Connection”; in F.M. Scherer – M. Perlman (eds), 1992.

--------, 1993. A Note: On privatization, contract technology and economic growth; in Day – Eliasson – Wihlborg, eds (1993).

--------, 1996a. *The Firm, Its Objectives, Its Controls and Its Organization*. Boston/ Dordrecht/London: Kluwer Academic Publishers.

--------, 1996b. ”Spillovers, Integrated Production and the Theory of the Firm”, *Journal of Evolutionary Economics*, 6, 125-140..

--------, 1997a.”General Purpose Technologies, Industrial Competence Blocs and Economic Growth”; in B. Carlsson, ed. (1997).

--------, 1998. ”From Plan to Market”. *Journal of Economic Behavior and Organization*, 34 (1), 49-68.

--------, 2000a. ”Making Intangibles Visible – the value, the efficiency and the economic consequences of knowledge”; in Buigues – Jacquemin – Marchipon (2000).

--------, 2001a. ”The Role of Knowledge in Economic Growth”; in Helliwell, John, ed., (2001).

----------, 2003, ” The Venture Capitalist as a Competent Outsider, in Alho, Kari-Jukka Lassila-Pekka Ylä-Anttila (eds), *Economic Research and Decision Making-Essays on Structural Change, Growth and Economic Policy,Helsinki: ETLA*

Eliasson, Gunnar – Åsa Eliasson, 1996. “The Biotechnological Competence Bloc”, *Revue d'Economie Industrielle*, 78-4$^{0"}$, Trimestre.

---------- 2002a **”**The Theory of the Firm and the Market for Strategic Acquisitions”, paper presented to the 9th Congress of the Intrernational Joseph A. Schumpeteers Society (ISS), Gainesville , Florida,USA, March 28-30,2002 .

--------, 2002b. ”Competence Blocs in the Experimentally Organized Economy”. KTH, TRITA Series.

Eliasson, Gunnar – Ove Granstrand, 1985. Venture Capital and Management – A study of venture development units in four Swedish firms (mimeo, Jan. 9). Stockholm: IUI; Göteborg: Chalmers University of Technology.

Eliasson, Gunnar – Christopher Green (eds.), 1998. *The Micro Foundations of Economic Growth*. Ann Arbor: University of Michigan Press.

Eliasson, Gunnar – Nils Karlsson (eds) , 1998. *The Limits of Government – on policy competence and economic growth*, Stockholm: City University

Eliasson, Gunnar – Erol Taymaz, 2000. Institutions, Entrepreneurship, Economic Flexibility and Growth – experiments on an evolutionary model in Cantner – Hanush – Klepper, 2000, *Economic Evolution, Learning and Complexity – Econometric, Experimental and Simulation Approaches*, Heidelberg/New York: Physica-Verlag

----------, 2002. ”Modeling Derivatives in a Firm Based Evolutionary Macro Model (MOSES) - The integration of computing, communications and financial services”, mimeo, KTH, Stockholm.

Eliasson, Gunnar – Dan Johansson – Erol Taymaz, 2002. ”Simulating the New Economy”, TRITA -IEO-R 2002:14, Stockholm:KTH, forthcoming in *Strtuctural Change and Economic Dynamics*. .

Hall, Bronwyn H. – Rose Marie Ham, 1999. ”The Patent Paradox Revisited: Determinants of Patenting in the US Semiconductor Industry, 1980-1994”, Working Paper 7062, March, NBER Working Paper Series, Cambridge, Mass.

Hall, Bronwyn H. – Adam, Jaffe – Manuel Trajtenberg, 2000. ”Market Value and Patent Citations: A First Look”, Working Paper 7741, June, NBER Working Paper Series, Cambridge, Mass.

Helliwell, John (ed.), 2001, *The Contribution of Human and Social Capital to Sustained Economic Growth and Well*-being, HRDC. Canada.

Hirschleifer, J., 1971. The Private and Social Value of Information and the Reward of Inventive Activity”, *American Economic Review*, LXI (4) (Sept.), 561-574.

Hultmark, Christina Ramberg, 1999, “ European and US Perspectives on Electronic Documents and Electronic Signatures”, *Tulane European and Civil Law Forum*, Vol. 14, pp123-53

Jaffe, Adam B. – Michael S. Fogarty – Bruce A. Banks, 1997. ”Evidence from Patents and Patent Citations on the Impact of NASA and Other Federal Labs on Commercial Innovation”, Working Paper 6044, NBER Working Paper Series, Cambridge, Mass.

Jaffe, Adam B. – Manuel Trajtenberg, 1998. ”International Knowledge Flows: Evidence from Patent Citations”, Working Paper 6507, NBER Working Paper Series, Cambridge, Mass.

Jaffe, Adam B. – Manuel Trajtenberg – Michael S. Fogarty, 2000. ”The Meaning of Patent Creations: Report on the NBER/Case Western Reserve Survey of Patentees”. Working Paper 7631, NBER Working Paper Series, Cambridge, Mass.

Johnson, Daniel K.N. – David Popp, 2001. ”Forced Out of the Closet: The Impact of the American Protection Act on the Timing of Patent disclosure”, Working Paper 8374, NBER Working Paper Series, Cambridge, Mass.

Jonasson, 2001. ”Innovative Pricing”, Doctorate thesis, Department of Industrial Economics and Management (INDEK), Royal Institute of Technology (KTH), Stockholm.

--------, 2002. ”Innovative Pricing in the Experimentally Organized Economy”, *this conference.*

Jorgenson, D.W. – Z. Griliches, 1967. "The Explanation of Productivity Change." *Review of Economic Studies*, XXXIV (3) (July), 249-282.

Kingston, William, 2000. ”The Case for Compulsory Arbitration: Empirical Evidence”, E.I.P.R. Issue 4

----------, 2002, ” Intellectual Property Needs Help from Accounting”, *European Intellectual Property Review*, Issue 11: 508-515.

Kortum, Samuel, 1994. ”A Model of Research Patenting, and Productivity Growth”, Working Paper 4646. NBER Working Paper Series, Cambridge, Mass.

Kortnum,Samuel- Josh Lerner,1997, Stronger Protection or Technological Revolution: what is behind the recent surge in patenting? NBER Working Paper Nr 6204 (Sept).

Kremer, Michael, 1997. Patent Buy-Outs: A Mechanism for Encouraging Innovation, Working Paper 6304, December, NBER Working Paper Series, Cambridge, Mass.

Lanjouw, Jean O. – Iain Cockburn, 2000. ”Do Patents Matter?: Empirical Evidence after GATT”, Working Paper 7495, January, NBER Working Paper Series, Cambridge, Mass.

Lanjouw, Jean O. – Josh Lerner, 1996. ”Preliminary Injunctive Relief: Theory and Evidence from Patent Litigation”, Working Paper 5689 (July), NBER Working Paper Series, Cambridge, Mass.

Lanjouw, Jean O. – Josh Lerner, 1997. ”The Enforcement of Intellectual Property Rights: A Survey of the Empirical Literature”, Working Paper 6296, December, NBER Working Paper Series, Cambridge, Mass.

Lanjouw, Jean O. – Ariel Pakes – Jonathan Putnam, 1996. ”How to Count Patents and Value Intellectual Property; Uses of Patent renewal and Application Data, Working Paper 5741, September, NBER Working Paper Series, Cambridge, Mass.

Lanjouw, Jean O. – Mark Schankerman, 1997, Stylized Facts of Patent Litigation: Value,Scope and Ownership , NBER Working Paper Nr 6297 (Dec).

----------,2001. ”Enforcing Intellectual Property Rights”, Working Paper 8656, December, NBER Working Paper Series, Cambridge, Mass.

Lerner, Josh, 2000a. ”150 years of Patent Office Practice”, Working Paper 7477, January,

NBER Working Paper Series, Cambridge, Mass.

--------, 2000b. ”150 Years of Patent Protection”, Working Paper 7478, January, NBER Working Paper Series, Cambridge, Mass.

--------, 2000c. ”Where Does State Street Lead? A first look at finance patents, 1971-2000”, Working Paper 7918, September, NBER Working Paper Series, Cambridge, Mass.

North, D.C., and R.P. Thomas, 1973. *The Rise of the Western World: A New Economic History*. Cambridge: Cambridge University Press.

Porter, Michael E. – Scott Stern, 2000. ”Measuring the ”ideas” Production Function: Evidence from International Patent Output”, Working Paper 7891, September, NBER Working Paper Series, Cambridge, Mass.

Reichman, J.H., 2001, ” Of Green Tulips and Legal Kudzu: Repackaging Righs in Subpatentable Innovation” in Dreyfuss,R.C., Zimmerman and First: *Expanding the Boundaries of Intellectual Property,*Oxford*:* Oxford University Press

Robinson, J., 1964. Solow on the Rate of Return, *Economic Journal*, Vol. 74.

Romer, P.M., 1986, Increasing Returns and Long-Run Growth, *Journal of Political Economy*, Vol. 94, No. 5 (Oct.), pp. 1002-1037.

Sakakibara, Mariko – Leo Branstetter, 1999. ”Do Stronger Patents Induce More Innovation? Evidence from the 1998 Japanese Patent Law Reforms”, Working Paper 7066 (April), NBER Working Paper Series, Cambridge, Mass.

F.M. Scherer – M. Perlman (eds), 1992. *Entrepreneurship, Technological Innovation, and Economic Growth. Studies in the Schumpeterian Tradition*. Ann Arbor: The University of Michigan Press.

Schleifer, Andrei, 1994. ”Establishing Property Eights”. Discussion Paper Number 1683, May 1994, Harvard Institute of Economic Research, Harvard University, Cambridge, Mass.

Schumpeter, J.A., 1911, *Theorie der Wirtschaftlichen Entwicklung*, Dunker und Humblot, Jena. English ed., 1934, The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle, Vol. XLVI, Harvard University Press, Cambridge, MA.

Shavell, Steven – Tanguy Van Ypersele, 1999. ”Rewards versus Intellectual Property Rights”, Working Paper 6956 (February), NBER Working Paper Series, Cambridge, Mass.

Solow, R.M., 1963. *Capital Theory and the Rate of Return*, Amsterdam: North-Holland.

Wihlborg, Clas, 1998a. The Role of Enabling and Mandatory Law for Financial Systems Efficiency”; in Eliasson – Carlsson , eds (1998).

----------, 1998b, Economic Efficiency with Enabling and Mandatory Law, in Eliasson-Green (1998).

Zucker, Lynne G. – Michael R. Darby – Marilynn B Brewer – Yushing Peng, 1995. ”Collaboration Structure and Information on Dilemmas in Biotechnology: Organizational Boundaries as Trust Production”. Working Paper 5199 (July), NBER Working Paper Series, Cambridge, Mass.