Chapter 10

INTELLECTUAL CAPITALISM AND BEYOND

Chapter Contents:

10.1 Chapter outline

This chapter will attempt to synthesize and discuss the findings in the preceding chapters as well as to elaborate further on the theme of intellectual capitalism as introduced in Chapter 1. After a brief summary of the preceding chapters, their implications will be pursued in the context of intellectual capital and intellectual capitalism, which is a phenomenon that has become even more established and pervasive in economic and technical life as of late. The chapter will in particular argue that the co-evolution of technology, TBFs, markets and legal systems will shape the economic system into what can be called intellectual capitalism

10.2 Summary of preceding chapters

Chapter 1 gave a background with some trends of general relevance: (a) growth and accumulation of S&T knowledge is becoming increasingly complex, diversified and expensive and controlled by private firms, especially large ones; (b) relative shifting from material to immaterial sources of economic growth; (c) strengthening of capitalism as an ideology and deployed economic order; (d) internationalization and globalization; (e) emergence of a multi-polar world that is politically, economically and managerially increasingly complex; and (f) emergence on a large scale of new information and communication technologies, i.e. infocom technologies or ICTs.

Chapter 1 also described the emergence of a pro-patent era in the USA in the 1980s, and the rising value of IPRs and intellectual capital. Japanese large corporations had notably developed patent resources on a broad front.

Chapter 2 showed how various basic IP notions among humans, such as ownership of secrets, fruits of intellectual labour and identity symbols, can be found in primitive societies as well as in ancient cultures and in various religions. These basic IP notions have largely persisted over time. Certain countries have then, since centuries ago, designed IPR systems

with the prime motive of fostering economic progress in society, thereby creating a new economic institution for IP. These systems have had similar basic features, which also have been surprisingly resilient over time, despite profound changes in industry and R&D over the centuries. Chapter 2 also conveyed the fact that in economic history and the history of technology there are no clear signs that IPRs have had a major impact on the whole. Neither have IPRs received much attention historically among economists and legal scholars in general. However, absence of the signs of effects need not be a sign of the absence of effects. The long run trend is that investments grow, technology cumulates and the links between technological changes and economic changes gradually become stronger. The impact of IPRs is thus likely to become more apparent sooner or later. The recent emergence of a pro-patent era may be interpreted as one such signal.

Chapter 3 gave an overview of innovation and diffusion processes and the role of patents in these processes. The pros and cons of patents were described from the points of view of inventors, companies and society. Finally, some economic literature and theory of patents and other IPRs was briefly surveyed. It was shown how patents, copyrights and trade secrets can be analysed in essentially the same framework, where possibilities to recover R&D investments for a new product are offered through possibilities to raise the operating profit margin and the market share during an initial time period on the market. Trademarks also give opportunities to raise operating profit margin and/or market share, but do not give any time-limited monopolistic powers on factor input markets as do patents.

Chapter 4 put IPRs, as a part of immaterial or intellectual resources, in the context of the firm as a viable capitalistic institution, operating in a nexus of markets: factor markets, product markets, super-markets for corporate control, and sub-markets for internal decentralized control. The nature of the intellectual capital based firm, with the technology-based firm as a particularly important case, was described, especially noting its resource structure and processes for resource acquisition, growth and diversification. The management

factor (including the entrepreneurial function) and the business idea, matching resources to market needs, were seen as key intellectual capital elements in any firm.

In Chapter 5, the rise of Japan to an industrial power and her deployment of an IPR system was described. Japan's lack of natural resources has prompted her to make a virtue of necessity by focusing on the build-up of intellectual capital resources, making Japan the first candidate for being an intellectual capital based state. The build-up process has chiefly been a catch-up process until recently, which has given Japan some special problems as well as skills of value for the next stage of innovative development. Skills in managing technology and IPRs are important examples of such skills. Chapter 5 also revealed some trends regarding IPRs, as assessed by the large Japanese corporations studied in the sample.

The quantity and quality of Japanese patents were then analysed. Various explanations behind the large flow of Japanese patents were discussed. In particular, factors with a long standing in Japanese history were emphasized as explanatory. Such factors include the early recognition of the patent system after the Meiji restoration and the long catch-up process, which was accompanied by special incentive systems and legislation and an emerging patent culture, especially in recent times. The emergence of a pro-patent era in the USA in the 1980s reinforced the factors contributing to the large volume of Japanese patents. The quality of Japanese patents has also increased and is currently equal or even in several cases superior to Western patents. Thus, there is a parallel between the quality movement in Japanese patenting to the quality movement in Japanese products.

Chapter 6 elaborated upon how new technologies were acquired and commercialized in Japanese corporations through various strategies.

Chapter 7 continued to describe and analyse corporate strategies, but now with a focus on IP strategies, i.e. strategies for patenting, secrecy and trademarks. The concept of multi-protection through the use of IPRs in combination was finally put forward.

Chapter 8 focused upon resources, organization and management of IP activities in the

large Japanese corporations. The emergence of IP cultures and comprehensive IP management skills in leading Japanese corporations was described in particular.

Throughout the empirical Chapters 6, 7 and 8, some corporate cases such as Canon, Hitachi and Toshiba were described in more detail. These companies operate in the information and communication technologies (infocom) sector, which is of particular importance to the formation of intellectual capital, as will be discussed below.

Chapter 9 reviewed the use of the other side of the patent coin, i.e. the use of patent information in technology and competitive intelligence. Again, large Japanese corporations have developed special skills and methods, and the methodology labelled "patent mapping" is described and illustrated. Such methods and other methods for technology analysis can be expected to develop further as different types of technology-related information are being produced and distributed electronically and become of increasing value as R&D costs and technology investment costs in general become more and more substantial. Appendix A further illustrates the use of patent information for corporate benchmarking.

10.3 Towards intellectual capitalism

10.3.1 Introduction

Since the downfall of the Soviet type of socialism, there is no doubt that capitalism in one form or another is as strong and globally active as ever. Needless to say, capitalism comes in many varieties and is evolving in various ways. Much has already been written on diverse types of capitalism, seen as emerging in contemporary society, such as, "alliance capitalism", "corporate capitalism", "Japanese capitalism", "shareholder capitalism", "informational capitalism" etc. (see Castells (1996), Gerlach (1992), Dunning (1988), Johnson (1993), Rosenberg and Birdzell (1986), Thurow (1996), Williamson (1985)). In this chapter, we shall elaborate on the notion of intellectual capitalism as a synthesizing theme, linked to the preceding chapters. We shall also argue that intellectual capitalism is evolving in society due

to various factors and with more or less unknown consequences, thus requiring intellectual preparation and institutional developments.

The arguments will be presented as follows. After a note on the concept of intellectual capitalim, indicators of the emergence of intellectual capitalism will be presented. The possibilities of a reversal will be discussed and dismissed. Then analysis and reflections will focus on ten levels: the individual, the profession, the company, the industry, the state, the market, as well as on technological, managerial, institutional and international levels. At the international level, harmonization of different national IP regimes will be discussed, albeit briefly. The prospects for a unifying intellectual capital paradigm for science, technology and culture – if needed at all – will then be explored, albeit much more briefly than the topic requires for policy action. Some needs for future institutional developments will also be identified. However, it is not the purpose of this chapter to formulate specific policy recommendations. Finally, an outlook on the future is given.

10.3.2 What is intellectual capitalism?

The concept of intellectual capital was introduced in Chapter 1 and further specified in Chapter 4 in the context of a firm. Intellectual capital essentially comprises all immaterial resources that could be considered as assets, being possible to acquire, combine, transform and exploit, and to which it is possible to assign, in principle, a capitalized value. “Intellectual” is thus used as roughly synonymous with “immaterial”. “Human capital” is commonly used to refer to intellectual capital specifically embodied in humans, excluding IPRs.

What then is intellectual capitalism? Standard dictionary and textbook definitions of capitalism refer to an economic system characterized by private ownership of the means of production and by operation of a market with enterprises competing for profit, etc.[1]

[1] According to Gardner (1988, p.4) an *economic system* is defined as "a set of institutions involved in making and

Hence a condition for intellectual capitalism to be present is to have private ownership of intellectual capital. This is what the intellectual property rights system as an institution allows. However, most intellectual property rights are temporary. When patents and secrets expire, the information content becomes public property.[2] In this sense, there is a feature of "intellectual socialism" as well. Still, if the share of industrially useful knowledge generated in the private domain compared to the public domain is large and if its growth rate is also large, then at some point privately held knowledge will dominate. For example, if technical knowledge is doubled every seventh year and all new knowledge is privatized through patents for twenty years before it enters the public domain, then close to 7/8 (= 87.5%) of the knowledge is under private ownership at any one point.[3] The exact figures are not important here, of course, but the fact is that if privately held knowledge grows faster than that which is publicly held, it will dominate in the not so distant future.[4]

In order to justify talking about the emergence of intellectual capitalism, it is also reasonable to require that intellectual capital in some sense dominates as a means of production, compared to physical means, and that it dominates capital values, investments and profit sources, although difficult to determine and relate to intellectual capital. Several indicators can then be used, e.g. Solow-type residuals[5], Tobin's q, Becker-type accounting of

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implementing economic decisions". An *institution* in turn is defined as "an organization, practice, convention, or custom that is material and persistent in the life and culture of a society" (op. cit.). Examples of capitalist institutions are business corporations, banks, competitive markets, property rights and profit motives.

[2] The circumstance that patented knowledge is publicly disclosed is equivalent to viewing it as privately owned knowledge being leased or licensed out for free under certain limiting conditions on its commercial use by the licensee.

[3] Since 20 years allows for close to 3 doublings, the stock of knowledge at the end of the 20th year is close to 8 times as large as the initial stock. This simple calculation assumes that all new knowledge is both patentable and patented. Similar calculations could of course be done for technical know-how held as secrets, taking into account the rate by which they leak out (i.e. "expire").

[4] de Solla Price has calculated that doubling times for scientific knowledge have been around 10 to 15 years for centuries (see Jantsch 1967). Scientific knowledge is not patentable in principle. However, assume for the sake of the argument that scientific knowledge with a doubling time of 10 years takes about a generation, say 20 years, to diffuse to a broader public, then only ¼ = 25% will be publicly held at any point in time.

[5] Solow-type residual refers to the statistical residual factor when output growth is accounted for by input of production factors such as labour, land and physical capital. Solow-type residuals have been interpreted as a

human capital, and the ratio of R&D investments to physical investments, a ratio that in many technology based firms exceeded unity in the 1980s (see Chapter 1). The practical accounting problems are large, however, and efforts are being made to develop new accounting concepts and methods.[6]

Other indicators of an emerging intellectual capitalism include the growth of intellectual capital based firms, professions and personal wealth, the emergence of technology markets and other intellectual capital markets, and the growth of intellectual capital products. In summary, one can observe not only a growing share of intellectual capital in traditional firms, products and professions but also a growth of "pure" IC firms, products and professions, and above all, a growing concern in many quarters about intellectual capital.[7] An overview of indicators is presented in Table 10.1

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measure of the technological progress of an economy, but they incorporate more factors than technology taken in an engineering sense, e.g. organizational factors. See Solow (1957) and Griliches (1996).

[6] The Scandinavian insurance company Skandia is one good example, see Edvinsson and Malone (1997). See also Stewart (1997), and Kaplan and Norton (1996).

[7] For the rise of intellectual capital based firms, see Granstrand (1998). For the increasing importance and functioning of technology markets, see e.g. Caves et al. (1983), Adelstein and Peretz (1985), Granstrand et al. (1992), Geroski (1995), Arora (1995, 1996) and Athreye (1998). For the rise of markets for innovative, small firms, see Granstrand and Sjölander (1990) and Lindholm (1994). For a classic work on the inherent problems in information markets, see Arrow (1962) and also Arrow (1997).

Table 10.1 Indicators of the growing importance of intellectual capital

Indicator	Indication	Reference
1. Ratio of intangible to tangible investments	Increase in both magnitude and recognition of intangible assets [1)]	European Commission (1998) TNO (1995)
2. Ratio of R&D expenditures / capital investments	Ratio surpassed 1.0 for large Japanese corporations in 1986. Conveys the emergence of a "Knowledge Industry."	Kodama (1995)
3. Solow-type residual	Aggregate growth is accounted for by factors other than labor and physical capital, primarily technology.	Pioneering works by Abramowitz (1956) and Solow (1957), followed up by many others (e.g. Denison (1985), see Griliches (1996))
4. Tobin's q-value	Emergence of intellectual capital based companies (pure as well as hybrid) [2)]	Tobin (1968, 1969) Hall (1993)
5. IPR values (patents, trademarks, trade secrets, copyrights, designs)	Growing registration [3)], value, litigation and damage claims.	Sirilla et al. (1992) Tri-lateral Report (i.e. JPO, USPTO, EPO (1996))
6. IP related crime and misconduct	Growth of intellectual theft, piracy, counterfeiting, infringement, and organizations dealing with these issues[4)].	Counterfeiting Intelligence Bureau (1997)
7. Trade in intellectual products	Emergence of technology markets [5)]	Bureau of Economic Analysis (1994)
8. Wages related to human capital (including personal image value of "stars")	Growth of salary levels in intellectual professions [7)]	Becker (1964) Frank and Cook (1995)
9. Sources of personal wealth	Emergence of intellectual capitalists [8)]	Forbes (1997)

Table notes:

1) 62% increase in intangible assets for the European Union 1985-92. Intangible assets rose 48% worldwide from 1989 to 1993 while total assets rose only 28%. Due to the nonconformity in company accounting for intangible assets, these numbers represent the increasing recognition of intangible assets as well as

conveying an increase in shear magnitude.

2) In Lewellan and Badrinath (1997), Tobin's q-values were calculated from a sample of 678 non-financial U.S. corporations from 1975-91. An upward trend ranging from a value of 1.082 in 1975 to 1.781 in 1991 is evident.

3) A 74% increase in worldwide patenting occurred between 1991-1995. Although first filings are on the rise, most of this increase was due to a large increase in subsequent filings. For statistics and an explanatory attempt, see Kortum and Lerner (1997). The number of IPR related lawsuits are also increasing, and in Japan faster than average (Arai 1997).

4) Worldwide counterfeiting was estimated at between 5-7% of total world trade in 1995, approximately 250BUSD. This constitutes an increase of around 150% from 1990 to 1995. Software piracy is estimated at around 46% of sales worldwide, costing manufacturers approximately 13.2BUSD in 1995.

5) U.S. royalties received and paid between 1987-1993 rose 106% and 162%, respectively.

6) The wage dispersion is larger than the IQ-dispersion in society for various reasons. The value of individual intellectual capital, as indicated by wages, derives not only from the value of competence but also from "relational capital" (see chapter 4), increasing returns and bargaining position.

7) A few examples of intellectual capitalists include Gates (Microsoft), Moore (Intel), Ellison (Oracle), Knight (Nike), and Clark (Netscape).

10.3.3 Reversal of the pro-patent era?

As described in Chapters 1 and 2, a pro-patent era arose during the 1980s, originating in the USA. The developments that led to the establishment of a pro-patent era were initially separate and had underestimated consequences, but gradually merged together with other developments, and gained momentum. Later, concern over various abuses of IPRs surfaced, signalling that the pro-patent movement might pave the way for, if not an anti-patent movement, at least some reformist movements. Concern over whether the US initiatives might backfire has also been raised. The question then is whether the pro-patent movement has gone too far, and whether it should be reversed or modified if possible.

Technically speaking, it is not difficult in principle to make legal changes that would

downplay the role of patents, just as a number of legal changes put the pro-patent era in motion. However, there are a number of counteracting forces.

Manageable growing pains

First, it is not clear that the pro-patent movement has gone "too far" in a broad sense. Many would argue that there are certainly abuses, but that they could be handled, as a first try by improvements (small adjustments) in the legal framework, rather than downplaying the system entirely. One should also keep in mind that the pro-patent movement is in a young stage and the associated legal framework still reflects the thinking of a previous era. Misfits and abuses could therefore be expected and accepted in a transitory stage for some time before they could be used as arguments for a reversal. The type of transaction costs incurred by the patent system in its totality can, moreover, hardly be persuasively shown to have risen too much compared to the viable alternatives. It may also be recalled that the strengthening of an IP regime is an attractive policy measure in IP-rich countries, since it does not incur large costs to government.

Large immaterial investments

Second, the patent portfolios and patent management skills built up within a number of large, leading corporations in the United States and Japan, as well as in other countries, represent considerable investments and competitive advantages to the individual corporations. These corporations will not easily accept a devaluation of their immaterial assets. Rather they will lobby for a continued strong patent regime.

Value of technical knowledge

Finally, it must be kept in mind that technical knowledge, like knowledge in general, is of steadily increasing economic importance and will therefore attract private efforts. Even if the

patent system was abolished altogether or a moratorium on patents was created, another type of IP regime would most likely evolve to take its place, at least partially.[8] After all, a secrecy-based IP regime is always a possibility.

Along this line of thought, it could even be argued that some kind of strengthening of IPRs would come sooner or later. This strengthening would not come about primarily because an advanced intellectual capital-rich nation wanted to correct tendencies to underinvest in R&D, but because it wanted to protect and exploit more fully the R&D investments of its industry.[9]

10.3.4 Rise of intellectual capitalists

The emergence of capitalism in connection with industrialization is commonly associated with the emergence of individual capitalists such as John Rockefeller, Andrew Carnegie, Cornelius Vanderbilt, Raoul Wallenberg, Alfred Krupp, etc. They typically amassed and commanded large resources as means for industrial production. These resources had been acquired through various activities (discovery of raw materials, technical inventions, financial inventions, speculation, manipulation, etc.), cumulated (through heritage, business expansion, etc.) and exploited. Intellectual capital in the form of business ideas, trade secrets, etc., naturally played an important role in this process, as did business skills and mere luck (see Chapter 4). However, on the whole, the ownership of physical and financial capital dominated wealth generation and distribution. Key features of the emergence of this type of capitalism included the resulting skew distribution of ownership and control of production means and the

[8] A moratorium on patents, i.e. a temporary and possibly selective stoppage of patent granting, has not been discussed but is nonetheless a possibility in principle. A moratorium could e.g. be argued to serve the purpose of mitigating abuses and slowing down the privatization of certain new, generic technologies and stimulate their diffusion, thereby allowing for lagging countries and firms to catch up. The use of shorter maximal patent lifetimes in some LDCs has been motivated on similar grounds. The threat of a moratorium might also discipline user and abusers of IPRs.

[9] One could ask why the US pro-patent developments in the 1980s did not occur earlier (see Chapters 2 and 5). Misplaced monopoly and tariff notions about patents, among free trade and competition advocates, were probably one delaying factor.

opposing roles of capital interest and labor interest.

As information, knowledge and competence cumulate and gain importance in industrial production, as well as in the economy in general, their role as a source of personal wealth is likely to increase. This can be checked by scanning the list of the world's wealthiest people and looking at the sources of their wealth and how it has changed over time.[10]

Such lists reveal a certain upward mobility of people basing their wealth more conspicuously on intellectual capital. However, this is not sufficient evidence for claiming that there is an increasing number of intellectual capitalists, only an indication.

The emergence of a few extremely wealthy intellectual capitalists is worth noting. More important, however, is the emergence of intellectual capitalism at the individual level. Knowledge and experience are essentially gained, held and used by individuals, directly or indirectly. Individual secrecy offers perfect excludability. As jobs and professions become more intellectual than manual, many of them become more dependent upon intellectual skills (e.g. creativity, competence and reputation) specific to certain individuals, like top researchers, artists, managers, surgeons and other specialists.[11] Such individuals with distinctive and not easily replicated competencies and personal images (see Chapter 7) then have possibilities to exercise rent control over their intellectual assets or capital. In principle, strategies available to companies to appropriate rents from new technologies, as described in Chapter 6, are available also for individuals who want to appropriate rents from their skills and knowledge. Secrecy is often a particularly effective method for individuals. Since individuals know more than they can tell, i.e. they also have tacit knowledge (in the words of Polanyi 1962), some secrecy is even a necessity at the individual level. Individuals can build up and exploit their competence in a manner similar to how companies build up and exploit their resources, as described in Chapter 4, in particular in regard to technical competence.

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[10] Such lists are provided e.g. by the journal Forbes. At the top of the Forbes 1997 list over most highly valued personal fortunes are William H. Gates III (with 36.4 BUSD related to Microsoft), Warren Buffett (with 23.2 BUSD related to holdings, e.g. in Coca-Cola), Hans Rausing (with 9.0 BUSD related to the Swedish packaging MNC Tetra Laval), and Yoshiaki Tsutsumi (with 8.0 BUSD related to Japanese real estate).

[11] Of course, there are mixed cases of manual and intellectual skills, like those of surgeons and musicians, as described in Ch. 4.

There are many strong complementarities among intellectual resources across individuals, who thus have incentives to combine them. There are also complementarities between material and immaterial resources. These complementarities are difficult if not impossible to capitalize directly through markets. Individuals often join various organizational forms such as teams, guilds, small or large firms, associations, universities etc. These organizational forms constitute the essential repositories of intellectual capital, complementary to intellectual capital held by individuals.[12] For example, one way to capitalize upon a business idea and complementary intellectual resources is to bundle resources by starting a small firm and, after some time, offer it for sale. The US wave of initial public offerings (IPOs) of small firms, whose valuable resources are mostly intellectual, illustrates this point. It is also illustrative that many of these IPOs pertain to firms based on information and communication technologies at large. New billionaires are created very fast in this way, much faster than billionaires were created among traditional industrial capitalists.

There are many individuals and small firms who prosper as well in more traditional areas of professional competence, e.g. lawyers, physicians, and accountants. There are also a growing number of new professional specialities based mostly on intellectual skills, such as consultants of various sorts. Thus, intellectual professions (intellectual capital based professions or intellectual capital services) are growing and diversifying.

Individuals usually exploit their intellectual capital through salaries from employer firms, which could be seen as the firm renting their embodied intellectual capital. At the same time employees learn and gain experience on the job and thus build up (appreciate) their individual intellectual capital further, which they can then capitalize on by salary raises, promotion, or changing jobs and/or employers. A sign of evolving intellectual capitalism at the individual level is the rising salary level in many intellectual capital professions. Large technology-based MNCs compete worldwide for the best talents, e.g. in R&D. This is particularly felt in R&D-intensive industries such as pharmaceuticals, computers and communications. These industries are, in this regard, probably precursors rather than exceptions. Of

[12] Thus note that the relation between intellectual labour and intellectual capitalists is different from the relation between manual labour and traditional capitalists.

course, demand and supply conditions vary within the S&T field, between countries and over time. Some areas in this labor market become overheated for some time, some specialties are substituted for others, etc. New discoveries may rapidly change the need for new competencies in an industry, while the educational system is slow to respond. Moreover, competence building is a slow process at the individual level, as we all know. Thus, imbalances between supply and demand on markets for S&T labour are likely to occur, especially shortages.

Higher education has been shown to pay off to individuals, at least in the USA, despite increasing costs. (See Becker 1993). Moreover, there are increasing wage differences in the USA and other Western countries, especially between jobs requiring specific intellectual skills and other jobs.[13]

Similar wage differences are emerging in Japan.[14] Otherwise intellectual capitalism at the individual level is not characteristic of Japanese society, at least not yet. Also, the formation of new, technology-based firms is not (yet) a well-developed form of entrepreneurship in Japan; neither is a venture-capital market, as is well known. Japan can be viewed as an emerging (albeit slowly perhaps) intellectual capitalist state, but the intellectual capitalism in Japan is more collectively oriented. It will be interesting to see if this state of affairs will persist, or if intellectual capitalism at the individual level will evolve in Japan as well.

10.3.5 Rise of intellectual capital firms and intellectual capital intensive industries

As knowledge in general, and technology in particular, increasingly cumulate and penetrate every economic activity, the resource bases of individuals, professions, firms, regions, nations etc. become penetrated to varying degrees. The rise of knowledge firms, knowledge industries

[13] It is interesting to note that salaries (as well as individual fortunes) seem to be more skewly distributed in a capitalist society than intelligence, although there are problems to measure the latter.

[14] Prof. Higuchi, personal communication.

and the like is thus commonly recognized and widely discussed. Here we talk about IC firms rather than knowledge firms, although the two concepts are closely connected. An important characteristic of an IC firm is its concern with the build-up and exploitation of immaterial resources – of which knowledge is one prominent part, but not the only part – and its concern with turning these resources into capital, subjected to some form of rent control for economic purposes.

The extent to which immaterial resources are transformed into intellectual capital differs, however, as does the concern over capitalizing and rent control. The share of intellectual capital in the firm's resources also differs, and firms could be roughly classified as having a minor, major, or dominant (>50%) share of intellectual capital. It is possible to conceive almost "pure" IC firms. Most, if not all, firms in a reasonable sense have some intellectual capital, as discussed in Chapter 4. This is not a new phenomenon. Yet, as mentioned above, there is a growing number of firms and industries in which intellectual capital dominates in some economic sense over other types of capital or resources as productive factors. Such firms, which we can refer to as typical IC firms, are found in R&D-intensive industries such as the pharmaceutical and infocom industries.[15] But they are also increasingly found in more traditional manufacturing industries as well as in service industries.[16] Then there are "pure" IC firms, in which intellectual capital is more or less the only productive factor.[17] These firms are growing in number and types. Examples are consultancy firms, e.g. in engineering and management, law firms, investment banking, software firms, and organizations such as universities, research institutes, music bands, art

[15] The concept of the infocom industry refers to the information industry and the telecommunication industry and includes especially data, media and telecom industries.

[16] The distinction between manufacturing and service industries is fuzzy and easily obscures the role of technology and intellectual capital in both. Therefore a discussion of a transition from manufacturing to service industries becomes difficult and even misleading, and will be omitted here.

[17] Note the possible distinction between the role of intellectual capital in the total capital structure and the role of intellectual capital as productive input. In principle, an IC firm can own lots of idle land, idle mines, etc., just as people, say on a farm, can have a lot of unexploited knowledge (idle minds).

companies and libraries, although such organizations are usually not thought of as firms.[18] Consequently, more "pure" intellectual capital industries arise, such as the management industry, the legal industry, the software industry, the music industry, etc., although not so commonly recognized as industries, at least not in their early stage of formation.

The formation of firms is also getting more intellectual capital-oriented. In other terms, entrepreneurship is getting more intellectual capital-based, both in "autonomous" entrepreneurship (in the form of independent inventors, new start-up firms etc.) and corporate entrepreneurship (in the form of start-up of new businesses within an existing large firm). New technologies (in infocom, biotech, materials etc.) provide plentiful opportunities, and more are likely to come in the following decades in view of growing R&D investments and technology combinations. [19]

The nature of managing IC firms differs in many respects from firms based on physical resources (e.g. regarding human resource management, accounting, marketing etc.). Other managerial skills, another business logic and other business models are needed. The pure IC firms such as R&D firms, software firms, consultancy firms, insurance companies etc. will probably lead the way in pushing the managerial frontiers (e.g. in accounting) in intellectual capitalism.

The emerging intellectual capitalism goes hand in hand with the rise of intellectual capital in firms and industries in general. In fact, it may be argued that large and small firms, especially technology-based firms, are leading the way into intellectual capitalism. The large firms currently control the lion share of the world's technology as indicated in studies of R&D

[18] Many organizations in this latter category lack motivation to capitalize their knowledge and extract rents from it in a narrow economic sense, and thus could be considered potential or dormant intellectual capital based firms.

[19] One could also refer here to possible long waves of innovations to come (i.e. so called Kondratieff waves; see e.g. Freeman et al. 1982). The baby boom from World War II also contributes to a boom of innovations. The following oversimplified but illustrative calculation may illustrate a likely link between demographics and innovativeness. If a substantial share of baby boomers are peaking in technological creativity when 35 years old and it takes, say, about 5–10 years to innovation and another 5–10 years to substantial diffusion, the 1990s would witness much innovativeness.

investments, patents and the like (see Pavitt 1991), and the concentration of technology to large firms is increasing. Large firms also team up with each other as well as with small firms for various reasons, not least for pooling and joint exploitation of their intellectual capital.[20] Thus, large firm complexes or quasi-integrated structures or networks emerge as an important feature of intellectual capitalism. This is not to say that small and new firms play a declining role in intellectual capitalism. On the contrary, new IC firms are a fundamentally important feature of intellectual capitalism, but small and large firms often develop in symbiosis.

As described in Chapter 4, the firm is a very viable economic institution, co-evolving with technology. There are, moreover, no signs of decline of this institution with some other kind of competing economic institution taking over. For example, with regard to IC formation, firms control most of the world's technology as mentioned above. Firms, large and small, are also increasing their role in science as well as in higher education, as both users and producers, not to mention as suppliers of educational material and equipment for science as well as education. Many universities, especially private ones, are also becoming more firm-like, with university management becoming increasingly influenced by business management, concepts and methods. At the same time, older institutions, which traditionally have played an important role in formal education, (historically the church and, in present days, government) are in relative decline.

The limited liability joint stock firm and the large firm in particular is thus a primary economic institution for intellectual capitalism, just as it was for traditional capitalism (see e.g. Rosenberg and Birdzell 1986). The nation-state, on the other hand, is becoming weaker relatively seen, as discussed by many authors. Its place and role in intellectual capitalism will be examined in Section 10.3.6.

[20] For example, the transition to more team-work among individuals in R&D has progressed further into team-work among firms in R&D. See Dunning (1988), who refers to this as a form of alliance capitalism. This is an example of how the economic pursuit of new, complex technologies call forth new managerial forms.

10.3.6 Rise of intellectual capital states

In the course of history, the rise and fall of nations has been linked to changing resource conditions and systems for acquiring and exploiting resources. Thus, it may be argued, as done by Abramowitz, Rosenberg, Wright and others[21], that the rise of the USA was in no small measure dependent upon her abundant exploitable resources of certain kinds and the capitalist system, as it evolved with e.g. the limited liability, joint stock company. The development of the US economy thereby came to be technologically congruent with its resources, to borrow a term from these authors.[22]

As technology advanced, in particular in the latter half of the 20th century, it opened vast possibilities to become less dependent on scarce natural resources. Examples are the invention of optical fibers, silicon chips and cellular telephony. At the same time, some countries poor in natural resources, Japan in particular but also South Korea, have chosen to make a virtue of their situation by investing in immaterial resources. Japan has thereby become a prime candidate for sooner or later becoming an intellectual capital-based state, or IC state, in the sense that intellectual capital occupies a dominating rank in the national resource base.[23] Japan would then present a new case of technological congruence. It can also be expected that Japan will push the frontiers of intellectual capitalism forward in the future (beyond the recession of the 1990s), although not alone. Important parts of US industry and regions such as Silicon Valley are similarly IC-intensive and will foster the further development of intellectual capitalism, as will most likely countries like South Korea sooner or later.

These examples will lead to emulation in other parts of the world, while new technologies will continue to lower the dependence upon natural resources. The role of

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[21] It is impossible to do justice to the works of these scholars in this limited space. The reader is therefore referred to their works, e.g. Abramowitz (1986), Rosenberg and Birdzell (1986) and Wright (1990).

[22] The concept could be seen as referring to a mutually reinforcing match between a technology system and a national economic system in a co-evolutionary process.

[23] This clearly does not imply that material resources are unimportant for Japan's development, nor does it mean that Japan has put her R&D efforts primarily into material resource saving technologies.

nation-states and their governments in this development can be of great importance in facilitating necessary transitions. But the economic powers will rather be concentrated among the collective intellectual capitalists, be they individuals or firms, and especially large firm complexes and their managers and prime governors. Many nations have poor economies, as far as the state is concerned, but the situation may be different in regard to their citizens and corporations.

Being an intellectual capital based state requires constant innovativeness. Many people have argued that Japan will for various reasons not become innovative on a large scale. However, their arguments are often weak and there is evidence to the contrary. This is an issue that can be elaborated at length. Suffice it to say that reality has already proven the innovative capability of Japan to a considerable extent in some areas. In addition, it is possible for Japan's industry to further internationalize and source and foster innovative talent abroad.[24] Nevertheless, moving to a more innovative stage definitely seems to require substantial changes in large parts of Japanese society, e.g. in the educational system and in the legal system, and failure to become innovative on a large scale might be fatal. Being innovative is simply a fundamental issue for the economic security of an IC state.

Various types of intellectual capitalism will emerge, including a particular Japanese variety. It is only natural to assume that hybridization of intellectual capitalism and traditional resource-based capitalism will take on various forms in various countries.

10.3.7 Rise of intellectual capital markets

Markets, as well as firms, are primary capitalistic institutions. Just as traditional firms become increasingly intellectual capital-based at the same time as more pure IC firms emerge, traditional product and factor markets become increasingly IC-oriented at the same time as more pure intellectual capital markets emerge. The arguments behind these statements for

[24] Immigration of non-Japanese innovators and entrepreneurs into Japan is not very likely for the foreseeable future, however. Note the importance of similar immigration to the US economy.

markets will not be spelled out here in the same detail as for firms. It should suffice to note that as products, services and firms become increasingly technology-based, or more generally IC-based, their corresponding markets become more IC-based as well. One example is pure information products like books, software, airline tickets and music sold over the Internet. Another example is the growing "super-market" for innovative firms (see Chapter 4). As the role of human capital is upgraded and professions become increasingly intellectual capital-oriented, so do the corresponding labour and service markets.

Intellectual capital markets may pertain to each of the intellectual capital elements described in Chapter 4, alone or in combination, i.e. bundled together into a "transactionable object." Of particular interest in this context is the emergence of technology markets of various kinds. Some of them have existed for a long time, e.g. markets for licenses (patent and know-how licenses, often in combination[25]), and engineering services. For these markets, the IPR system has traditionally been of decisive importance as it defines tradable objects (see Chapter 3). Some new markets have emerged in recent decades, e.g. markets for trading small, technology-based firms and projects and various venture capital markets and OTC stock markets. As technology can be embedded in products, services, labour and firms, markets for these may also be looked upon as embedded technology markets.

The difficulties involved in creating and operating intellectual capital markets should be noted. Inherent properties of information, as dealt with in Chapter 2, give rise to a number of problems including market deficiencies, market failures and economic crime – with information markets.[26] Nevertheless, many information markets do function and actors learn how to operate in them. As for technology markets, the codifiability of various technologies, which is limited in emerging technologies but is improved through further R&D, does offer possibilities to overcome some of the problems with information markets. That is, it may become possible to specify technologies sufficiently for trade to occur without revealing so much that the risk of mere theft or fraud frustrates the technology trade. In other words a kind

[25] For some interesting studies, see Arora (1996), Caves et al. (1983).

[26] For a classic work on this, see Arrow (1962).

of second order codifiability exists and could be further developed. In addition, technological interdependencies imply interdependencies among market actors over time, which offer some possibilities for self-policing among actors. Still, it is likely that a kind of IC-related economic crime will continue or even develop further, and that this will threaten the performance of intellectual capital markets.

Internal intellectual capital markets have also emerged and continue to emerge in large corporations (i.e. sub-markets as dealt with in Chapter 4). Quite normally, companies sell various professional services internally, including R&D. Some companies even use licensing internally as well as trade projects internally. Diverse schemes are employed, some of which are rather pseudo-market in nature.

Finally, it should be noted that some types of exchange in society could take on characteristics of an intellectual capital market. Mutual building of trust, relations and obligations among humans could be seen as formation of relational capital that could generate benefits and could be transferred to some extent. Another example, as pointed out by Schumpeter, is political voting which might be viewed as a market-like exchange oriented around trust and power. Political ventures are also acquiring more business-like characteristics. This is not necessarily for the better, but nevertheless, it can be taken as support for the increased concern to manage relational capital as part of intellectual capital.

An important example relates to communication or the mere exchange of information. This can be seen as a bartered exchange of intellectual capital. When clear utilitarian concerns enter into such exchanges, it is justified to regard them as constituting intellectual capital markets to some extent, even though these markets may be very differentiated or specific to the parties in the exchange. However, if information is exchanged for money, it is a clear-cut market transaction. New information and communication technologies open up vast possibilities to codify, store and transact information and thereby possibilities to convert the traditional bartering of communication into regular markets for information. This is dealt with in Section 10.4.

10.4 Technology and intellectual capitalism

10.4.1 Role of the intellectual property system

Let us first discuss how the intellectual property system affects technology and then move on to how new technologies affect the evolution of intellectual capitalism. Society's main rationale for having a patent system is to stimulate technological innovation and diffusion (Chapter 3). Thus, by design, there is an impact of the intellectual property system upon technology. The size of the impact is debatable (Chapter 2). The impact on R&D investments could be substantial in some industries, particularly in drugs and chemicals (Chapter 5). Technology-based corporations increasingly emphasize the role of patents and employ elaborate patenting behaviours and strategies (Chapters 6 and 7). In addition, patents are complemented by other intellectual property rights into a multi-protection scheme in order to exploit the company's R&D and new technologies (Chapter 7). Given rising R&D costs, abundant technology-based business opportunities, strong intellectual property regimes and improved technology and intellectual property management skills (Chapter 8), there is little reason to believe that this trend of strengthened intellectual property rights, will be reversed, at least not in the short and medium term.

However, at the same time, there are increasing signs of, and concern over, intellectual property rights counteracting their purpose and hampering technological progress and entrepreneurship, especially among small firms. Such signs and concerns are of great age, but are increasingly justified for several reasons.

Evolution of technology

The changing character of technology creates misfits between technology and the legal framework designed to foster it. It is an inherent tendency that changes in legislation lag behind changes in technology, legislation being by tradition and design more reactive than

pro-active or anticipatory when facing uncertainty. Today, technology advances fast, perhaps faster than ever in absolute terms. Some of these new technologies challenge fundamental concepts in the intellectual property system, and it is not clear at the outset whether and how they could be given protection under the current intellectual property regime. Well-known examples are software and biotechnology. Less well-known examples are new surgical methods, new teaching methods or even new athletic techniques, depending upon how broad the concept of technology is interpreted. As the cost and prospective value of new technologies and inventions increase, the push for intellectual property protection will increase. To some extent the intellectual property system will evolve to accommodate such new technologies and inventions, although cases and periods of underprotection as well as overprotection will most likely occur. Yet, a more challenging problem for the intellectual property system remains. New technologies are interacting with each other and with old technologies in complex and interdependent ways. As a result, products and services become not only increasingly based on new technologies but increasingly based on many different technologies. That is, products and services become more multi-technological, or "mul-tech" for short, which is different from becoming "hi–tech" in the sense of using some advanced, new technology. At the same time more generic (or "general purpose") technologies appear, so in this sense, technologies become more multi-product also. All in all, the cross-links between new products and technologies proliferate. This means that patents and businesses become more cross-linked and interdependent with each new business becoming reliant on an increasing number of patents and each new patent having an impact on an increasing range of businesses on average.

Sources of technology

The sources of new technologies proliferate as more firms and nations invest in R&D. In addition, firms increasingly internationalize their sourcing and exploitation of new technologies (i.e. both factor input and product output markets become more global). Thus, in

a new technology as well as in a product market, there will be not only more players on average, but increasingly interdependent players in a mixture of cooperation and competition ("coopetition "or "competeration"). Technology trade, e.g. through licensing and cross-licensing, then becomes increasingly necessary. This is because the intellectual property rights necessary to sustain a business become increasingly fragmented among players, who are ready to enforce or otherwise exploit their rights, thereby creating a web of problems (e.g. hold-ups).

Abuse of the IP system

The two factors mentioned so far put increasing demands on the well-functioning of technology markets. Strategic firm behaviour in using and abusing the intellectual property system is yet another factor that further complicates the functioning of technology markets. Some inventors and small non-manufacturing firms act as "patent extortionists". Large corporations, on the other hand, aggressively build up patent portfolios and employ various patent strategies. They, moreover, combine them with various other intellectual property rights into a kind of multi-protection, and thereby build up bargaining and retaliatory power. As IP-based bargaining power increases in industry, asymmetries in bargaining power become more likely to appear – between new and old firms, between small and large firms, and between companies adapted to strong and weak intellectual property regimes in different sectors and countries. These asymmetries put innovation and entrepreneurship at risk, which especially endangers small manufacturing firms. (New types of insurance are being tried but with expensive premiums.) Thus, due to several factors, the intellectual property system may slow down, misdirect or hold up innovation and diffusion, although not necessarily discouraging all R&D investments. Consequently, there is, as always, a mixed verdict over whether the intellectual property system promotes technological innovation and diffusion, but perhaps the doubts in the mix are increasing. The pendulum continues to swing between trust in and suspicion of the intellectual property system.

10.4.2 Role of new technologies in general

Now, what about the question: how will new technologies affect the evolution of intellectual capitalism? At a general level the creation of new business opportunities based on new technologies is crucial. Is there any reason, though, to expect that the technology wells will dry out? Although some limits to new technological discoveries are definitely conceivable in the long run, there are certainly no signs of limits for the foreseeable future, at least for a few generations ahead.[27] Mother Nature has strange ways of exhibiting herself, but she will not stop doing so, although she will never totally expose herself to mankind. On the contrary, progress of all sorts in various S&T fields is being made at a high, perhaps accelerating pace.[28] New advances in different fields of S&T combine to produce still more new advances. Thus, there is cross-fertilization with a combinatorial mechanism, and as long as technological opportunities multiply through some combinatorial mechanism, their growth will be self-sustained. In addition, fundamental breakthroughs e.g. in physics or medicine, and the emergence of new generic technologies (e.g. new materials with design of material properties at atomic level), continue to fuel the opportunity-generating process.[29] At the same time the "life cycles" of such S&T advances are long, encompassing several human generations.[30]

But is there a need for new technologies? Again with appeal to conspicuous realities

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[27] Cf. limits to observation posed by Heisenberg's uncertainty relation. Notions of limits to invention, exhaustion of discoveries etc. are old and persistent, as are their refutations. As an example, the US Patent Commissioner Charles H. Duell around 1899 voiced the opinion that all major inventions had already been made. A recent work expressing a similar opinion for science is Horgan (1996). Schumpeter refuted "the widely accepted view that the great stride in technological advance has been made and that but minor achievements remain." (Schumpeter 1976, p. 117) by referring to the promises held out (in the 1940s) by chemical, electrical and construction engineering and the fact that future technologies are uncertain and therefore one cannot reason that there are diminishing returns to new technological discoveries.

[28] Any observed slowdowns have been temporary so far, e.g. the decline in patenting in the USA in the 1970s. Needless to say, the yield to R&D and inventive efforts in terms of potentially patentable advances is difficult to observe.

[29] More examples are superconductivity and gene splicing.

[30] Just think of semiconductivity, discovered in the late 1930s.

(poverty, diseases etc.), one can dismiss most claims that the needs of the world to which technology may cater will cease to exist in the foreseeable future. Yet, what about effective demand (i.e. the demand for real products by solvent customers) being less than a general need? In the advanced, industrialized parts of the world, the demand for new technologies shows no signs of decline for several reasons.

Old technology creates demand

This demand is derived to some extent from the need to deal with various side-effects or consequences of earlier deployed technologies, e.g. the need for environmental protection. In this sense, new technologies generate new demand, although usually with a time lag. One can argue about the balance on the whole and claim (as Ellul (1990) does) that technology continues to create more problems than it can solve. However, even if new technologies on balance create more problems than they solve (which is hardly provable), it does not follow that effective demand for them will decline. As long as the costs and benefits of new technologies are unevenly distributed in society, which is likely to be the case, politically strong groups will evolve as beneficiaries, supporting effective demand.

New technology creates demand

To some extent, new types of demand are created by new technologies, e.g. demand for new types of information or audio-visual entertainment created by information and communication (infocom) technologies. More generally, as uncertainty grows with increasing complexity in society, the need for information grows, especially when production and distribution of information create information asymmetries, which is the case under intellectual capitalism. Thus intellectual capitalism will reinforce itself with respect to production and distribution of information.[31]

[31] Note that in both Marx's and Schumpeter's analyses of capitalism in their days, they emphasized the auto-

Persistence of old demand

Old types of demand persist, some of which are insatiable, e.g. in health care and life prolongation (and vanity as well for that matter). In these areas, new technologies are continually presenting new prospects. One might argue that some types of old demand are declining. For example, it can be said that the demand for new military technologies, derived from the demand for security, will decline in the apparent aftermath of the cold war. Unfortunately, that seems far from true, at least to any radical extent in the long run. On the contrary, needs for security as well as justice will live on and, as wealth accumulation and inequalities proceed together with uncertainty, the demand for technologies to enhance security and property protection at all levels in the global society will persist and probably increase.[32] Again, we see here an element of self-reinforcement, not only in intellectual capitalism, but in capitalism on the whole, which is derived from the excludability characteristics of private property and unequal access.

Conspicuous demand

The need for "conspicuous consumption", to use Veblen's concept,[33] will persist and probably grow, e.g. in Japan and other *nouveaux riches* Asian countries. Much of this need is technology-related, and some demand new technologies, largely because they are new.

Insatiable demand

Various demands, old and new, technology-derived or not, tend to be insatiable by any

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destructive character of capitalism on the whole in the long run, that is they argued that capitalism will destroy itself (but for different reasons).

[32] These are projections made also by the growing firms in the security provision business (e.g. Securitas), having developed far away from padlocks and guards.

[33] See Veblen (1965).

particular set of new technologies. Improvements are attained, but they are seldom, if ever, ultimate solutions. It is true that some technologies come into dominance for long periods of time, yet not because they offer perfect solutions, but because it happens to take time to find and implement sufficiently better ones.[34] Sooner or later technological substitution sets in.

Technological substitution

On balance, the rate of technological substitution seems to increase rather than decrease, as life cycles of new products and technologies tend to become shorter. Despite cases of technology persistence (Graham 1956), technology conservatism (Bohlin 1995), technology monopolies (Arthur 1988), dominant designs (Utterback 1994), technological interdependencies and lock-ins (Rosenberg 1994) etc., technology competition and technology substitution rule in the long run.

Population effects

Demand is of course affected further by changes in population. The possibility that such changes set in to the extent that demand for new technologies would vanish is slim indeed, however.[35]

Profits from innovation

In summary, there is a persistent, effective demand for new technologies, but will there be further technological opportunities and will there be possibilities to make private profits from investment in them? More specifically, how will these opportunities to profit from innovation

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[34] An often quoted example is the QWERTY design of alphabetical keyboards; see David (1985) and Arthur (1988). The claimed superiority of the so called Dvorak keyboard, that challenged the dominance of the QWERTY design, is highly disputable (see Liebowitz and Margolis 1990).

[35] In his discussion of the possibility of vanishing investment opportunities on the whole, Schumpeter also dismissed this factor (1976, pp. 113–114).

be affected by the new technologies themselves? This is our question at hand. That is, will new technologies improve the possibilities for innovators to appropriate the rents from innovations for which there is both a potential demand and supply?

First of all, innovations may become very profitable, even extremely profitable, as witnessed by various studies (e.g. Scherer 1998), but innovations are often associated with many failures, false starts and high costs. The dispersion of profits from innovation may even deter entrepreneurs from proper investments. The question is not so much whether imitators will "free-ride" innovations and reap large profits as well, but whether prospective innovators can trust their capabilities of making sufficient profits to justify their investments, compared to their alternative investment opportunities. These alternatives include the opportunity to engage in a waiting game, that is to wait and see if someone else innovates and then imitate. There are also (currently growing) opportunities to sell the innovation "packaged" as an innovation company on markets for corporate control.

The capability to control the rent streams from the immaterial resources or intellectual capital deployed in the innovation process becomes a crucial consideration, especially as innovations become increasingly based on intellectual capital. One may argue that information cannot be owned.[36] Neither can humans be owned, and outright slavery in intellectual and creative work, e.g. in R&D, is practically infeasible, at least under democratic forms.[37] Therefore intellectual capitalism would have a weak basis in the form of private ownership in firms, according to this line of argument. However, and this is important, ownership per se is not the primary issue. Rather, it is how private parties (firms, individuals) can control (manage) the rent streams derivable from immaterial resources and turn these streams into intellectual capital. The separation of ownership and control issues is thus important to consider.

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[36] Many authors have made such arguments; see e.g. Thurow (1996). Also note the expression "information wants to be free". See also Branscomb (1994).

[37] Examples of a kind of intellectual slavery can be found in the dictatorial transfer and use of scientists in Nazi Germany and the post-war Soviet Union. Needless to say, productivity suffered as did the scientists.

In order to control resource rents, excludability is critical, that is, possibilities to lock in customers and lock out competitors. This is true regardless of the material or immaterial character of the resources. However, excludability varies among resource types and business situations. In general, excludability is more difficult to accomplish for immaterial resources, which is precisely why intellectual property rights have been instituted. Thus, one way to raise excludability, and thereby the possibilities to appropriate resource rents, is to bundle resources having low excludability with resources having high excludability. This is typified by embedding immaterial resources in material ones, which in business jargon is sometimes referred to as "productification" or "commodification". Immaterial resources can also be embedded in individuals and in small companies, which could be put up for sale. Thus, product markets, labour markets and stock markets offer ways to appropriate benefits from immaterial resources and products in addition to "pure" markets for such resources and products. For the latter type of markets, it has always been a problem to enforce excludability and prevent free-riding as well as theft. However, excludability is not a given, but can be changed by new technologies. Infocom technologies especially offer new possibilities to raise excludability while also lowering transaction costs.

10.4.3 The role of infocom technologies

The natural way to exclude others is by means of secrecy, which is effected by the balance between secrecy-enhancing and secrecy-destroying (intelligence gathering, scanning) technologies. This balance shifts over time. Code-making and code-breaking have always had their problems, but currently (1997) it seems as if encryption technology has reached a point of very high efficiency in ensuring cheap, high-quality secrecy, which can be made widely available.[38] Such secrecy-enhancing technologies in a broad sense will have extremely important consequences, as they can radically improve excludability for business purposes as

[38] Encryption codes have been considered munitions in the USA and subjected to export controls. Thus companies like Netscape, who use some encryption in their software, have had to comply with these controls, being classified as munition companies.

well as for military purposes.[39] On the other hand, various instruments, chemical analysis, surveillance, and sensor technologies facilitate reverse engineering, which in turn facilitates both imitation and infringement detection, thereby having a mixed impact on excludability.

In fact, who benefits from what, how, where and when is largely an informational problem, as are billing and money-handling. Thus, as infocom technologies advance, it might be expected that various transaction costs could be lowered so that investors can remunerate themselves more easily through higher excludability. This applies to goods in general, which therefore would narrow the range of public goods, everything else equal.[40] For example, signalling and sensor devices at gates to toll roads that automatically identify cars and credit their registered owners or drivers would facilitate private road investments on profitable routes. Similarly a range of traditional public goods and services will be – and already is – affected by new infocom technologies aimed at raising excludability. Broadcasting is a classic example of public goods that are affected as well, where scrambling, coders and decoders, standards and two-way communications enable producers to charge their users through pay-TV and pay-radio.[41] The extent of traditional broadcasting will, moreover, be diminished by new technologies offering interactivity and selectivity to consumers. This also holds for the traditional broadcasting method of teaching. Broadcasting, once referred to as a "democratic technology", is being replaced, at least in relative terms, by interactive and selective communication. Thus, infocom technologies enable investors and producers to build electronic locks and fences around their properties in order to generate and control their rent streams. These possibilities may not be welcomed by society at large, and various forces may counter them.

The possibilities and tendencies to raise excludability through new technologies favour

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[39] Criminal businesses are also greatly aided by encryption.

[40] Recall that public goods are characterized by low excludability, non-rivalry in use and a high ratio of fixed costs to variable costs. Note that egalitarian or human rights aspects do not enter the definition of public goods.

[41] Technology-based excludability can also be used for political purposes, of course, as when North Korea blocked its TV viewers from South Korean programs by using another standard. Actually, creating incompatible standards is a way to enforce a certain kind of excludability.

capitalism, including state capitalism, but do they favour intellectual capitalism in particular? It is argued here that in fact they do, although we have barely seen the beginning as yet. Moreover, they do so not in isolation, but in combination with other factors. In any case, they open up possibilities for privatization of immaterial resources and the appropriation of rents. This is partly due to their bundling with material resources and improved excludability in relation to the resulting products and services. In addition, many informational products or services are likely to be made proprietary and subjected to private rent control more easily through different infocom technologies. These technologies not only produce and distribute more information faster, but they produce and distribute more differentiated information at more differentiated rates. New information of relevance to intellectual capitalism is far from solely produced through traditional R&D, although new technical information (i.e. new technologies) constitutes perhaps the most important part of immaterial resources and is a main driver of intellectual capitalism. For example, new sensor technologies (in a broad sense, including technologies for detection, registration, measurement, identification, surveillance etc.) enable the collection of vast amounts of data of all sorts.

These data have value in themselves, although often only in isolated instances. However, when they are cumulated and combined with other data, their value may be considerably raised, thus giving an incentive to build data bases, expert systems and the like. (Think e.g. about all the transactional information that can be gathered from ‘electronic traces’ through credit cards, cash cards, bar codes, phones, TV-shopping, Internet, etc. and used not only for marketing but also for extending and creating markets linking consumers together with similar tastes and spending and moving habits.) Moreover, new information (text, data, sound, images) is increasingly produced in electronic form (e.g. in publishing), further enabling the build-up of computerized data bases that can be equipped with access control and customized search and filtering techniques.

These databases can be and are being made proprietary and have become great sources of controllable rent streams by various means. Examples of such means are exclusive access

to data sources and data suppliers, speed in updating information with a time value, subscriber and feedback arrangements with users, etc. These kinds of information production thus enable the accumulation of intellectual capital. [42]

Altogether, information asymmetries proliferate through new infocom technologies. These asymmetries may be temporary, and sometimes they may be reduced, e.g. through interventionist rules and regulations. In any event, the information asymmetries essentially create lead times in some market operation. Secrecy-enhancing technologies or other access-restricting technologies may, moreover, prolong the market lead times.

In addition to faster communications with more differentiated rates, other trends in communications and information distribution are of relevance to intellectual capitalism. Human communications are becoming increasingly electronic and embedded in telecommunication systems. Electronic communications need equipment with access possibilities. They also require a certain level of resources and competence to operate, as well as absorptive capabilities at the receiving end. Second, telecommunication networks proliferate into "networks of networks" with increasing demand for dedicated, private networks complementing open, public ones, further increasing connectivity. Third, telecommunications in turn are becoming increasingly interactive and selective, multimedial and asynchronous at the same time, in order to save time by using asynchronous time slots and comparative advantages of audio and video messaging in every day life. This also requires routing, switching, storage and retrieval, in turn requiring technical machinery. Audio-video conversion technologies like speech to text conversion are likely to become revolutionizing communications. Fourth, human-to-human communications are increasingly complemented and/or replaced by human/machine communications, with machines both as intermediaries (e.g. answering machines) or as end communicators (e.g. computerized databases, possibly with voice control and intelligent dialog systems). Also, machine-to-machine communications is growing (with terminals communicating with each other or with

[42] New information businesses grow under various labels currently in vogue, labels such as 'data warehousing' and 'data mining'. A new breed of knowledge entrepreneurs or information exploiters is also growing.

control systems with computers, switches, routers, servers etc., and with new types of intelligent antennas).

As a result of such communication trends, (that is, trends in the distribution of information) possibilities open up for control of access to information and information flows by private interests, which are difficult if not impossible to efficiently regulate by public bodies.

There are also trends in information production towards more information in total, more codified (especially digitalized) and electronically processed information, more produced, altered and stored information, more differentiated and tailor-made information, and more information overflow. (The latter requires costly capabilities for information search and filtering – possibly aided by devices such as search engines and information agents, e.g. "Internet assistants".) The trends in information production combined with the trends in communication result in increasing informational asymmetries and proprietorship, which in turn creates market lead times and possibilities to extract rents from information. The market lead times deriving from information asymmetries are typically temporary, and they may even be quite short, depending upon the rate of diffusion of new information. Still, at any given point in time, a substantial amount of information is likely to be in the hands of just a few actors.[43]

Still more important, perhaps, is that the time needed to exploit any asymmetry may be quite short. The profit margin can also be kept higher if other actors are unaware of their information lags (i.e. a kind of second-order secrecy applies). If any proprietary investments for creating the asymmetry can be kept sufficiently small, total profitability is ensured.

Thus, an important feature of intellectual capitalism is the control of rents from temporarily held immaterial resources such as information. Infocom technologies are

[43] As an analogue to illustrate the amount of information asymmetries in an economy, note that spontaneous (or epidemic) diffusion of information often follows a logistic process. If new information flows into the economy with a certain rate, and diffusion takes time to penetrate a population, at each point in time in a stationary state only a limited share of the population will have access to all new information.

important in creating these temporarily held resources as well as in facilitating the control of rents from them.

Other technologies may also be thought of as facilitating the creation of market lead times as well, such as technologies for laboratory automation, manufacturing automation (lab and fab automation), marketing (e.g. through Internet) and distribution. However, these are not technologies that could typically be directly used to create market lead times through slowing down seller diffusion or building entry barriers with a temporary duration. Technologies may be used to speed up the time to market but they create market lead times only to the extent that they are unevenly distributed among actors.

Communication networks, such as the Internet and related private network designs (intranets, extranets), are highly important for the emergence of intellectual capitalism. They provide various kinds of intellectual capital products and intellectual capital markets as well as the means for exclusive access, especially with new kinds of protocols and digital payment systems. The Internet has also given rise to a number of intellectual capitalists, as have infocom technologies and other technologies in general, e.g. Bill Gates, Steve Jobs, Rupert Murdoch, Hans Rausing and Ralph Landau. (Compare the latter with traditional capitalists like Rockefeller, Carnegie and Vanderbilt.).

How do technologies that lower copying and imitation costs, specifically reproduction costs, for informational products affect the market, that is technologies that help overcome or destroy rather than encance excludability? The moving print type, which appeared in the 15th century, greatly reduced the cost for the reproduction of books, and thereby enlarged the market for those kinds of intellectual products. Xeroxing similarly lowered the cost of copying. In neither case was there a complementary technology (in contrast to legal means) that could help the information-originator to appropriate or control the rents from the original information. Software copying is also cheap, technically speaking. Legal protection against software piracy has also been strengthened. However, more efficient methods to control software copying or access, based on new technologies as well as on new business methods,

are available. The high stakes involved on global markets promote progress in this field. Again, new infocom technologies offer possibilities for rent control, for instance, the bundling of services (like software support); the lack of interoperability, standards or gateway technologies; biometric user identification and registration; codes; etc.

Additionally, users do not want to become locked in by high switching costs. Many users (including corporate users) count on having the possibilities to make some extra copying for free, which some producers may tolerate. Thus, there is an element, considerable at present, of a black market. In some cases, producers also encourage copying and diffusion of certain software with the intention to hook (lock in) users on future products and services. But this is another attempt at rent control. Regarding large-scale software piracy, producers, especially in the USA, will probably find a mix of technological, managerial and political solutions that reasonably fulfill their purposes, at least in the parts of the world which are open for policing and enforcement in some way.[44]

Thus we may conclude that, by and large, new technologies are fostering the emergence of intellectual capitalism, while intellectual capitalism fosters the emergence of new technologies in a positive feedback loop (i.e. in a virtuous or vicious circle depending on political taste). New infocom technologies are especially important to this positive feedback in the techno-economic system in society. Such a link between new technology systems (i.e. families of interrelated technologies) and the emergence of new ways of organizing an economy, i.e. new economic systems, was also present in the rise of early capitalism in connection with industrialization. The new technologies of particular relevance to the first industrial revolution were new energy technologies, epitomized by the steam engine, and new material-processing technologies, characterized by the loom and the mill (saw mill, steel mill etc.).[45] However, new technologies by themselves do not change anything in isolation from

[44] Since society does not (yet) provide police forces for enforcement of IPRs, IPR holders have to organize their own policing. Examples of private enforcement initiatives, probably a sign of a growing trend, are the formation of BSA (Business Software Alliance) and Counterfeiting Intelligence Bureau, see ICC (1997).

[45] See Freeman et al. (1982) for a good overview of attempts to link "Kondratieff waves" of new technology systems to fundamental changes in the economic system or changes in the "techno-economic paradigm" in the

management, policies and institutions. This is the subject to which we now turn.

10.5 Management and intellectual capitalism

It has earlier been argued that there is an emergence of IC firms of various types, of which the technology-based firm (TBF), focused on in the preceding empirical chapters, is a particularly important example. One can speak of a still broader category of knowledge-based organizations, which further includes universities, libraries, consultancy firms etc.[46] While certainly not a new phenomenon, knowledge-based organizations grow in numbers and types as knowledge accumulates and becomes more differentiated in general.

Knowledge-based development is accompanied by a corresponding development of management resources, in themselves knowledge-related.[47] To the extent that management can be viewed as a resource, one could speak of supply and demand of management as well as of a management market, a management industry and similar concepts (see Chapter 4). What is important in this context is to recognize that there is an evolution of management, just as there is an evolution of technology. There are many examples of how new managerial specialities and innovations have evolved (e.g. international marketing management, industrial R&D management, database management, etc.).

Thus, capabilities for managing knowledge-based organizations will develop as the organizations themselves evolve and place new demands on their management. In particular, IC management will develop, implying accumulation and differentiation of managerial

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words of Freeman and Perez (1988). See also Rosenberg and Frischtak (1984).

[46] The concept of a knowledge-based organization, for which there are many terms, is not easy to define precisely, and the concept obviously runs the risk of becoming a catch-all. Nevertheless it will be used here to refer primarily to organizations with knowledge-related resources as a predominant part. Needless to say, many authors have dealt with such organizations in one way or another.

[47] A fairly recently coined term for the management of knowledge-related resources is ‘knowledge management’. For an overview, see e.g. Shariq (1997). Strictly speaking knowledge management is embraced by IC management but is a broader term than technology management, with technology taken to mean a body of knowledge about techniques.

knowledge and skills in how to acquire, develop and exploit intellectual capital resources, subject to various forms of competition and utilitarian considerations. Traditional industrial management practices and theory have co-developed together with the traditional industrial firm and its traditional resource structure. As IC firms evolve and the role of intellectual capital in the traditional firms evolves, IC management will develop gradually in some directions, and radically in others.

This does not necessarily mean that IC management will develop into a special new sub-discipline of management or that there will be a special new breed of intellectual capital managers. What it means is that management of intellectual capital will become more skilful ("professional"), sophisticated and resourceful in terms of experience, concepts, tools, methods etc. Improvements will stem from both gradual learning by doing and through discrete managerial innovations. Several lines of managerial developments are likely to become closely interconnected into a web of management skills constituting IC management.

One line runs from technology management, which since the 1970s has broadened the traditional R&D management.[48] A second line runs from patent management, which in the 1980s started to become broadened into IP management. A third line runs from personnel management, broadened into human resource management, concerned with competencies, creativity, relations, motivation of intellectually talented people etc. A fourth line runs from sales management, broadened into marketing management, including not only concerns with trademarks and image (reputation) building, but broader concerns of how to market, distribute and sell knowledge, embodied as well as disembodied, on consumer as well as industrial markets. Closely related is purchasing management, which will develop correspondingly to attend to the purchasing of knowledge, embodied as well as disembodied. However, such purchasing, e.g. licensing in or recruitment, is mostly subsumed under technology management and human resource management. Nevertheless, improved skills in both marketing and purchasing management contribute to the well-functioning of intellectual

[48] Technology management then attends to e.g. various other forms of technology sourcing than only in-house R&D.

capital markets, e.g. technology markets, given a suitable institutional framework (legislation etc.).

A fifth line runs from management accounting and control, which actually is a crucial line for the furthering of IC management, due to the need for new measurements and the inherent problems involved. There are other conceivable lines from traditional management to IC management as well, but the purpose here is to illustrate rather than survey them in order to highlight some contours of the more comprehensive IC management, which is long on future but short on history.

Given that we can see not only some emerging components of IC management, but also improvements of its functioning over time, it is evident that IC management will foster intellectual capitalism, just as it has been fostered already. In that respect, intellectual capitalism as a phase of capitalism becomes congruent with IC management just as intellectual capitalism becomes congruent with infocom technologies. The difference is that IC management is developing more directly in response to intellectual capitalism than infocom technologies are. The point here is that some of the currently recognized limitations of IC management, in its current state as a cluster of fragmented management skills and responsibilities, are likely to recede in years to come. This is both because new IC management skills will develop, and because technologies supporting IC management will develop, not least infocom technologies.

Thus there are a number of positive feedbacks among intellectual capitalism, IC management and infocom technologies. What then are the consequences of these developments? Where will this troika lead us? What about the institutional developments that are crucial to intellectual capitalism and to capitalism in general? This will be dealt with next.

10.6 The future of the intellectual property rights system

What is likely to happen with the intellectual property rights systems in the world ahead? This

is of course discussed widely in many forums. Here, only an overview will be given.

Pro-patent movement

As discussed above major reversal of the pro-patent or pro-intellectual property movement is not likely. On the contrary, this movement is likely to continue, with the USA as the leading activist, at least for the years to come. However, certain features of the intellectual property systems will be tempered, altered and added.

International harmonization

Is the international harmonization of the intellectual property systems likely? Is it desirable? These questions are extensively discussed in NRC (1993). Practitioners are often advocating international harmonization (perhaps less so amongst lawyers and patent attorneys). One argument is that diversity in national innovation systems promotes innovativeness, and therefore diversity in national intellectual property rights systems is a positive factor (see Foray 1994). However the intellectual property rights system diversity comes at a cost, and any necessary diversity could be maintained in other ways. International harmonization of intellectual property rights systems is highly desirable regarding their key aspects, such as grounds for priority (first to file vs. first to invent), because of the costs that are otherwise incurred in and around innovative work.[49] International harmonization is also increasing and is likely to continue. Regional harmonization has advanced in Europe through the EPO. Every year new countries are joining the PCT system, and a community patent might not be far away. Harmonization between the regions of Europe, Japan, and the USA is also progressing. The MNCs, through their lobbying organizations, are an important factor behind this drive. Internationalization of corporate and national economies is also important. Internationalization of the national legal systems in general is much slower, implying that the

[49] The prognosis that "first to file" will sooner or later be the predominant ground in the world, including the USA, has already been mentioned, in Chapter 2.

internationalization of intellectual property legislation is pushing legal harmonization at the national level. Some MNCs are also internationalizing their litigations (suing in different national jurisdictions). North-South harmonization is more of an open issue.

It might further be argued that the current system with national patent offices could be substantially consolidated on a global basis[50]. This may not currently be such a "hot" political issue, but the potential for rationalization is there, reinforced by the potential of new infocom technologies[51]. Competition among national patent offices is likely to emerge first and is already underway in Europe. Economic integration together with price/performance-conscious MNCs, in conjunction with an increasing need for both broad and deep competence in the patent office, will be driving forces; political and cultural factors (e.g. language factors) will hamper progress, but to a weaker degree in the longer run.[52] Political forces behind "strong" patent offices are also likely to aid competition, once set in motion. Nevertheless, the national systems of patents have developed over centuries, from time to time considerably influenced by national protectionism, which still is and will continue to be a significant hampering force.

Abuses of the patent system

A third issue is how to deal with abuses of the patent system. Many examples surfaced in the pro-patent era. In general, one may expect that various "fixes" will be initiated, especially by the US, rather than major overhauls (see Merges 1995 and Warchofsky 1994).

One might believe that the level of inventiveness (non-obviousness) required for patent-ability should be raised. Narrowing the scope of a patent, especially in emerging technologies, might benefit developments. These measures are necessary to decrease the hold-up problems

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[50] The *Changes for Breakthrough* report by the Commission on Intellectual Property Rights in the 21st Century recommends a worldwide patent network linking the tri-lateral patent offices (i.e. JPO, USPTO, EPO).

[51] The JPO says it will develop Cyber Patent Services by 2005.

[52] The language factor in general as a national "glue" is weakening fairly rapidly since English is gaining ground as a global language in S&T and business, as well as among younger generations. Infocom technologies enabling, e.g broadcasting and Internet, together with provision of contents in English further boosts English as a global language. Gradually English is also becoming a global language in education.

and blocking power of many minor patents, as well as the blocking power of major patents in applications remote from their original area of application. The costs of patent processing and patent litigation, too, could be lowered in this way.[53] Future patent flooding may also increase considerably when (rather than if) countries like China start patenting on a broad scale. Moreover, it is probable that "computer-aided patenting" will come into play. That is, computers and expert systems will generate certain types of inventions (e.g. based on combinatorial alterations of inventive elements) or inventive inputs that form the basis for patent applications.[54] Such computer-generated inventions are likely to be minor, and non-obviousness requirements must reasonably filter away most of such inventions.[55] The impact on R&D and innovation efforts, as well as on diffusion of technical information, would probably not be significantly weakened in total by raising required levels of invention and limiting patent scope, but this must be analysed further.

Harmonization of IP regimes

A fourth issue is whether intellectual property regimes will and should be harmonized. Different co-existing intellectual property regimes have evolved over time, linked to various sectors of society and their institutions, organizations, norms, etc. Science and universities constitute one, industry and technology another, military and government still another, and culture and artists a fourth. These intellectual property regimes are partly overlapping and interdependent, and this trend increases as technology and economic concerns continue to penetrate modern societies. Clashes between intellectual property regimes more frequently

[53] The substantial costs, times and uncertainties of patent litigation have always raised concern, see e.g. Babbage (1832), Vaughan (1925) and Kingston (1995). For a recent overview, see Lanjouw and Lerner (1997).

[54] This may appear as a preposterous scenario to some, but it is in fact quite feasible. Computer-generated musical compositions, art pieces, poems, visual patterns, logos, trade marks etc. are improving, as is the understanding of creative processes. In fact, a company called Invention Machine Corporation is moving in the direction of computer-aided patenting (or computer-aided innovation – CAI). The company originates from the idea of the Russian patent examiner Genrich Altschuller who postulated that there are general principles of invention (in fact an old idea elaborated by many scholars and inventors) that he and his collaborators discovered in examining millions of patents. (See also Chapter 9.)

[55] Cf. the difficulty to apply the non-obviousness test to computers instead of professionals.

occur e.g. in industry/university collaborations. Table 2 shows the differences between the intellectual property regimes in science and technology. Pressure is thereby arising to align different intellectual property regimes with each other and to find common solutions.[56]

[56] For a discussion of the traditional IP regime in science, see e.g. Nelkin (1984), Merton (1988) and Long (1991), and Stephan (1996) and Eisenberg (1987) for how it may clash with the IP regime in technology and industry. The distinction between science and technology is becoming blurred, however, (see e.g. Narin and Noma 1985). The division of intellectual labour between universities and companies is also less clear , with companies doing basic research (see e.g. Rosenberg 1989) and universities taking out patents (see e.g. Bertha 1996).

Table 10.2. Comparison of intellectual property regimes in science and in technology

Regime feature	Science	Technology
Priority	First to publish (First to discover/write)	First to file (First to invent)
Criteria	Newness to the field Non-obviousness	Newness to the world Non-obviousness Industrial
Examination system	Publishers Journal editors and referees	Patent offices Patent examiners
Opposition system	Informal	Formal
Sanction system	Informal	Formal
Legal basis	Copyright matters codified in law, otherwise weak Professional norms	Codified in patent law
International coordination	Strong in some disciplines. No unifying framework or treaties	International treaties and cooperation
Licensing provision	General permission to use "publication pool"	Usually subject to patent holders' discretion
Remuneration system	Citations Reputation Community prizes and job offers Research grants Non-contract-based Promotion	Royalty or lump sum payments or barter Product or license sales Contract-based

10.7 The future of intellectual capitalism

It might be considered far-fetched to look at the possible future of intellectual capitalism, as it has not had much of a history and presence yet. Still, some early thinking about its future may be a worthwhile undertaking. What about any self-destructive or stagnating tendencies in intellectual capitalism? What about issues of past concern in capitalism – capital concentration, obsolescence of the entrepreneurial function etc. These are all pending questions for the future.

To be sure, the future of capitalism attracted great attention at each stage in its past. Among scholars, Marx and Schumpeter stand out. Several works of current scholars have already been mentioned. Table 10.3 gives an overview of the works of some widely recognized scholars on the future of capitalism.[57]

While there is substantial consensus among current scholars that we are approaching a so-called information (knowledge, service etc.) society (age, era etc.), there is not (yet) much emphasis on aspects like private ownership and control of information and its rent streams.

In summary, it has been argued here that we are witnessing a gradual transition or evolution to intellectual capitalism, from and still co-existing with traditional capitalism. New technologies in general, and infocom technologies in particular, constitute a major factor out of several interdependent factors behind the transition. Other important factors would include intensified international competition; rise of large MNCs; managerial developments; rise of countries like Japan (being poor in natural resources); US activism; and institutional developments.

[57] Other and more works could have been selected, of course. Rosenberg and Birdzell (1986), Rosenberg (1992), Thurow (1996) and Drucker (1993) have been chosen as recent works by prolific and well-known writers, together representing both economics and management perspectives.

Table 10.3. Characterization of some authors on the future of capitalism[1)]

Author	Future of capitalism	Main characteristics of future stage	Type of transitory mechanism	Main driving factors in transition
Marx	Socialism/ communism	State-owned means of production	Self-destruction	• Growing social pain and inequalities • Wasteful business cycles, instability, duplication and differentiation • Concentration of capital and political power • Exploitation of workers and public resources • Growing hostility among workers against capital owners • Worker-led revolution
Schumpeter	Socialism	State-owned means of production	Self-destruction	• Increasing obsolescence of the entrepreneurial function • Destruction of protecting stratum • Destruction of capitalist institutional framework • Growing hostility towards capitalism
Drucker	Post-capitalism	Knowledge as primary resource Capitalist institutions survive New "classes" – managers, service workers, intellectuals	Gradual evolution[2)]	• Knowledge and knowledge workers • Management • ?[2)]
Rosenberg	Evolution	Continued experimenting and modification of capitalist institutions	Self-construction	• Inherent experimental feedback structure
Thurow	Stagnation	Capitalism with stronger dependence upon human capital and "brainpower" industries	Lack of competing economic system	• Technology • Ideology

Notes:

1) These characterizations are gross simplifications by necessity.

2) A specific transitory mechanism is not explicated, nor is a set of main driving factors.

Certainly, many past concerns over the effects of capitalism apply to intellectual capitalism as well, such as concern over capital concentration, inequalities and unemployment, all of which may be aggravated in intellectual capitalism. Unemployment in certain types of more intellectual capital oriented professions may also gradually become substantial. If so, there may not be a growing government or public sector to absorb intellectuals who might otherwise instigate social unrest.[58]

New concerns over intellectual capitalism are also likely to appear. A most probable example is economic crime, or intellectual capital theft and fraud in and among developed and developing countries. Infocom technologies may actually offer attractive crime opportunities because of the expensive policing and law enforcement. In fact, there will be substantial difficulties in providing proper legislation in a timely manner.

Overall, various types of transaction costs could become exceedingly high in intellectual capitalism. On the other hand, infocom technologies might also offer new opportunities to lower them, but probably at the cost of increased societal control and perceived losses of personal integrity and freedom. Thus, intellectual capitalism may clash with one set of fundamental human values.

One conceivable scenario for the future, admittedly in a technocentric spirit, is that new technology systems will again change the economic system. Such a future change would be away from intellectual capitalism, perhaps to new or hybrid forms of economic systems which are not readily classifiable as capitalistic. A new family of technologies is emerging in and around biotechnology and medical health care - let us call them biohealth technologies. Today, such technologies emerge under quite capitalistic forms in corporations and also to a varying extent in hospitals and related institutions, at least in the USA. The patent system itself has traditionally worked best from a company point of view in the chemical and pharmaceutical industry, and now

[58] This was pointed out by Schumpeter as a feature of the welfare state in Sweden in the past.

the system is being extended into genetic engineering. However, the generation and exploitation of biohealth technologies clash with fundamental humanistic values. At a global level, with less homogeneous capitalistic traditions, such clashes may increase to such proportions that intellectual capitalism has to change. Possibly pressures for change will also come from the greying baby-boom generation of WWII, if the health care sector does not perform satisfactorily under capitalistic forms that are put in place.

Another scenario is that national struggles over intellectual capital will become destructive on a large scale. Military escalation may of course arise from such struggles or fear of them, just as from traditional struggles over land and other physical resources (like fresh water). In addition, military power will be intellectual-capital-intensive in itself.

10.8 Summary and conclusions

Despite various prophecies to the contrary – wishful or not – capitalist economic systems are as strong as ever after the rise of competitive Asian economies, the downfall of the Soviet Union, and the current resurgence of the US economy. Capitalism may come in many varieties, however. This chapter has argued that capitalism is now being transformed into a most important new form, what can be called intellectual capitalism. In broad terms intellectual capitalism can be interpreted as a confluence of a capitalist economy and a knowledge or information economy. More specifically, intellectual capitalism refers to an economic system with basic capitalist institutions (private property rights, private profit, competitive markets and free enterprise) in which productive assets and processes, as well as commercial transactions and products, are predominantly intellectual or immaterial rather than physical in nature. Despite palpable problems to account for intellectual capital and products (an exciting research area in itself) an unfolding shift towards intellectual capitalism is indicated by various indicators (Solow-type

residuals, Tobin's q, Becker-type human capital accounting, intangible investment ratios, emergence of a pro-patent era, share of corporate R&D to total R&D in the world, growth of technology markets and markets for corporate control, etc.).

This chapter further argued that the main driving force behind this shift is technological change and the accumulation of new technologies in general. More specifically, the family of information and communication technologies, infocom technologies or ICTs for short, plays a pivotal role in the emergence of intellectual capitalism, not unlike the role played by the family of material and energy technologies in the emergence of original capitalism. ICTs not only enable fast, cheap and differentiated production and distribution of various old and new types of information, but ICTs also enable recording, codification, packaging and mass marketing of information, making it commercially available at a low transaction cost. The traditional malfunctioning of pure information markets thereby becomes mitigated. Consequently, human communication and information barter, be it on a habitual, altruistic or profit basis, becomes more easily commercialized. Vast opportunities to profit from innovation and increasing competitive pressures at all levels in society will ensure that, in fact, information and communication will become far more subjected to commercial transactions than we have as yet expected, let alone hoped.

A number of key functionalities are offered by ICTs to support intellectual capitalism. Increased codifiability, connectivity, processability, interactivity, selectivity, and controllability in communications deserve special mentioning. These functionalities enable economic agents to profit from information, e.g. by raising excludability through building electronic locks and fences around information assets. Although we practically have a global intellectual property rights system in place, ownership of information per se, (including knowledge, competence and data) is not the decisive issue for intellectual capitalism. Rather, it is the ability of economic agents to control the rent stream from information that is crucial. Such control has traditionally been

accomplished by embedding information with physical products or with individuals and more recently by embedding it with small companies as well. Appropriation of benefits has then been accomplished by using product markets, labour markets and stock markets. ICTs now significantly enhance the possibilities to control rent streams from intellectual capital and products and raise excludability and lower transaction cost without necessarily relying on intellectual property rights, although IPRs increasingly matters as well. Thereby, intellectual capital management with technology management as an important part becomes a key managerial issue in most companies, large and small. Old companies and organizations in general, such as libraries and universities, will have to transform and adapt, and new ones will appear such as data mining companies, information brokers and content providers. Similarly, intellectual capital oriented policies (for education, R&D, etc.) become of key governmental concern, especially in nations like Japan and South Korea, being poor in natural resources. However, by and large, it is yet too early to fully identify all managerial and policy implications of the emerging intellectual capitalism.

New technologies play two main roles for intellectual capitalism. First, they constitute a lion share in the generation of intellectual capital and products and second, and more specifically for ICTs, they serve to privatize the benefits from intellectual capital and products by raising excludability and lowering transaction costs. The Internet with its web sites is a most important illustration of how ICTs play both these roles and thereby foster intellectual capitalism on two accounts. Internet provides a market place in the true, original sense of the word - a meeting place for prospective buyers and sellers, displaying merchandise and quoting prices with possibilities to communicate over prospective transactions. The market place provided by Internet and related networks is rapidly growing into an efficient, fast, global mass market with numerous information products and linked databases and with a concomitant rapid growth of electronic commerce in general. However, the fastest growth will probably be in information and multimedia related commerce, especially with the next generation of Internet protocol and digital

payment systems enabling click and pay functions also for ”microtransactions” of information on a large scale.

This chapter concluded with two scenarios. One regards the future of the intellectual property rights (IPR) system, originally designed to foster innovation but perhaps increasingly counteracting its own purpose. However, amid the rhetoric of sceptics, a reversal to a weak IPR regime is not likely. Rather, fixes will be attempted, as well as further international harmonization and rationalization. A certain convergence of the IPR regimes, linked to science and technology respectively, is also likely.

The second scenario regarded the future of intellectual capitalism altogether. Various authors (e.g. Marx, Schumpeter, Drucker, Thurow, Rosenberg) have emphasized different self-destructive, evolutionary or stagnating tendencies inherent in capitalism. As for intellectual capitalism it is probably not overly technocentric to assume that new families of technologies will appear that will again fundamentally change the economic system, gradually or not. For example, a new technology family or technology system is emerging in and around biotechnology and health care, what we perhaps can call biohealth technologies. It is not inconceivable that intellectual capitalism will increasingly be perceived in society to clash with fundamental humanistic values, especially in connection with biohealth technologies. Such clashes may very well spur the emergence of new types of economic systems, be they capitalist, quasi-capitalist or something else, yet to be identified.

Just as Schumpeter described the process of “creative destruction” within the capitalist system, capitalism itself may undergo a similar process. Although intellectual capitalism may represent an advancement in the development of capitalism and create greater opportunities for those firms that exploit its potential, this does not imply that society as a whole is better off.

In religious belief systems Adam and Eve were punished for eating from the tree of knowledge, and Zeus punished Prometheus for giving fire to mankind. The message here is that

knowledge, and technology in particular, is power, and power is dangerous. Although knowledge can be used to enlighten, it has too often been used to suppress and dominate. Ultimately the fruits of knowledge, growing higher and higher up in the tree, may not be so sweet to mankind as we compete for a taste without learning how to control our appetite.