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Irene Troy and Raymund Werle

Uncertainty and the Market for Patents

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Abstract

Modern societies regard knowledge as a production factor in its own right. The market is the prevailing governance mode of their economies, and it is supposed to be the most appropriate mode of trading and allocating knowledge assets, too. But socio-economic research has revealed that knowledge markets are far from functioning smoothly. Building on ongoing qualitative research into patent trading we suggest that the emergence of a well-functioning market for patented new technological knowledge is confronted with several obstacles, which can be characterized as different facets of uncertainty. They are included in the process of creation of innovative knowledge, in its transformation into a fictitious knowledge commodity (patent), in its uniqueness, in the strategy of transaction partners, in the estimation of the future market potential of final products (based on the patent), and generally in the problem of incomplete and asymmetric information. Also a commonly accepted method of determining a patent's value is missing. We analyze structural and organizational responses to the problem of uncertainty. Potential traders often rely on contractual options, especially licensing agreements, and complementary procedural principles facilitating the trade of patents.

Zusammenfassung

Moderne Gesellschaften betrachten Wissen als einen eigenständigen Produktionsfaktor. Die Wirtschaft dieser Gesellschaften koordiniert sich in zunehmendem Maße durch den Markt, der als angemessener Modus der Allokation von und des Handels mit Wissen angesehen wird. Einschlägige sozioökonomische Studien zeigen allerdings, dass von einem Markttausch höchstens eingeschränkt die Rede sein kann. Auf der Basis einer laufenden qualitativen Untersuchung zum Patenthandel identifizieren wir unterschiedliche Facetten umfassender Unsicherheit, mit denen die Akteure in diesem Feld konfrontiert sind. Die Quellen der Unsicherheit liegen im Prozess der Entwicklung innovativen Wissens und dessen Transformation in eine fiktive Ware (Patent) ebenso wie in der Einzigartigkeit des patentierten Wissens. Aber auch die Schwierigkeiten, das Marktpotenzial eines auf dem Patent basierenden Endprodukts einzuschätzen, die Strategien der Transaktionspartner und generell die Probleme unvollständiger und asymmetrischer Information verursachen Unsicherheit. Zudem gibt es keine allgemein akzeptierte Methode, den Wert eines Patents zu bestimmen. Wir analysieren strukturelle, organisatorische und prozedurale Reaktionen auf das Problem der Unsicherheit und zeigen, dass potenzielle Handelspartner auf vertragliche Vereinbarungen, insbesondere Lizenzverträge setzen, um Patente zu handeln.

Contents

1	Introduction	5
2	Creating Property and ownership of technological knowledge	9
3	Transactions and markets	11
4	Uncertainty	13
5	Sources of uncertainty	14
6	Coping with uncertainty	16
7	A market for patents?	20
	References	21

1 Introduction

Current trends in the development of modern societies suggest a growing importance of knowledge and knowledge-based technologies. Intangible assets account for an increasing part of the value of companies, and intellectual property (IP), in particular, has become a critical economic resource beside land, capital, and labor. The economically most significant resource is technological knowledge. This type of knowledge, which Mokyr (2002: 1–27) calls “useful” knowledge, includes instructions and techniques usually stored in technical artifacts. They facilitate the manipulation of natural phenomena in order to fulfill a human purpose. Generating and augmenting, but also distributing and allocating, useful knowledge appear to be essential requirements of the welfare of modern knowledge societies. In order to cope with these requirements, the societies increasingly rely in ideology and policy terms on the market as the seemingly most efficient mode of distributing and allocating not only goods and services but also knowledge (cf. Djelic 2006).

A functioning market is expected to reward the most promising technical innovations and to direct investments into areas where the creation of new knowledge is most useful. But even though we already entered the “pro-patent era” in the 1980s and new useful knowledge has been rising as regards the number of codified innovations and the value of intellectual property the market exchange of IP is developing slowly (Granstrand 2000: 2–12). Recent socio-economic research indicates that markets for intellectual property are far from functioning smoothly.

Table 1 Distribution of patent uses

Exclusive internal use	50.5%
Licensing	6.4%
Cross-licensing	3.0%
Licensing and internal use	4.0%
Blocking competitors	18.7%
Unused (sleeping patents)	17.4%
(n = 7,714)	

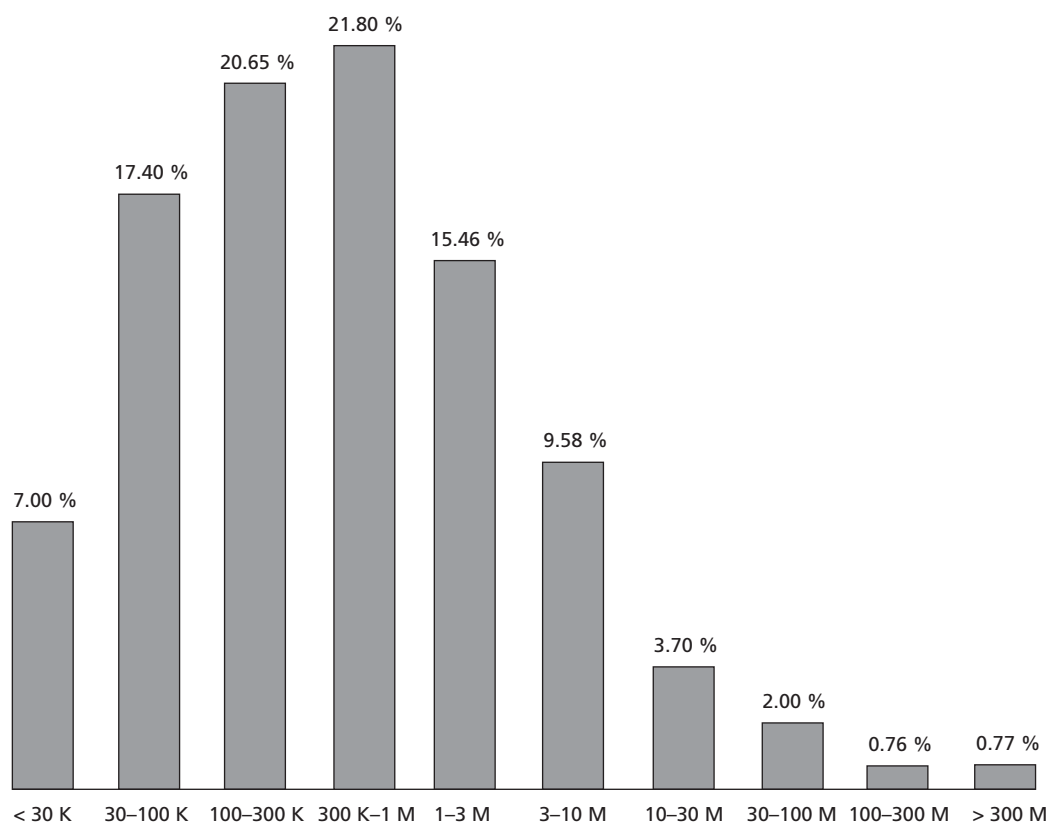
Source: PatVal-EU Project – Gambardella (2005: 40).

The PatVal-EU project, an extensive study of the value of more than 9,000 European patents in six EU countries (DE, ES, FR, IT, NL, UK) in 2003/04, surveyed the use of these patents (Table 1). It provides evidence that about 36 percent of the patents are not deployed for internal use or licensing. While about one half of these patents (18.7 percent) may even assume a potentially high value as they help block

competitors, the other half (17.4 percent), called “sleeping patents,” are left virtually unexploited (PatVal-EU Project – Gambardella 2005: 39, 40).

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Figure 1 Distribution of patent value estimates (in euros)



Source: Gambardella/Giuri/Mariani (2005: 45).

Similarly, a survey conducted in 2005 among firms in technology-based industries in Germany shows that about 25 percent of their patents – roughly 100,000 – were unused. Based on the price at which a firm would agree to sell such patents, the study estimates the potential value of all unused patents to add up to 8 billion euros (Institut der deutschen Wirtschaft 2006).

Some of these patents may be of low economic value and therefore lack demand. The figures of the PatVal-EU survey show that, indeed, only a small proportion of patents is valued highly by their owners, who were asked to quote the minimum price at which they would have sold the rights on the very day on which the patent was granted. The distribution of patent values is skewed to the left, with the majority of patents on the low-value side (Figure 1).¹ Only 16.8 percent of the patents are worth more than 3 million and 7.2 percent rank above 10 million euros (Gambardella/Giuri/Mariani 2005: 44–47).

¹ Note that figure 1 shows the log of the values. The actual value distribution is even more skewed.

Table 2 Patent value by patent use (selection)

Value	Use				All Patents
	Licensing	Internal use	Blocking Competitors	Unused (Sleeping) Patents	
Less than 100,000 euros	16.6 %	22.4 %	27.1 %	32.4 %	25.3 %
10 million euros or more	9.2 % (45)	7.7 %	7.2 %	4.9 % (66)	7.2 %
Number of observations	(494)	(3,895)	(1,443)	(1,342)	(7,714)

Source: Authors' calculations based on: PatVal-EU Project – Gambardella (2005: 44).

Table 2 suggests that low value is an important reason why many patents are not licensed. 32.4 percent of the sleeping patents have an estimated value below 100,000 euros, and only 4.9 percent are estimated at 10 million euros or more. In contrast, only 16.6 percent of the licensed patents have a value below 100,000 euros, while 9.2 percent rank at 10 million euros and higher.

But low value is not sufficient explanation for why many patents are not licensed – not to mention the fact that it remains unclear whether low value is either the cause or the effect of the low volume of trade. Phrased in absolute terms: More patents with a value over 10 million euros are unused (66) than licensed (45). While about 11 percent of all patents are licensed (not including cross-licensing), “for another 7 percent the owner was willing to license but did not, which suggests that the market for patents could be almost 70 percent larger” (Gambardella/Giuri/Luzzi 2007: 1164). In the final project report, the PatVal-EU research team estimates the value of the actual “European Market for Patents” to equal 15.6 billion euros in 2002. According to their approximation, the potential value – given a functioning market – would even amount to 24.4 billion euros (PatVal-EU Project – Gambardella/Giuri/Mariani 2006: 21, 22).² We certainly have to treat such calculations with caution. But there can be no doubt that a fair share of valuable patents that the owners would like to license is not licensed.

The following two quotations illustrate that conventional economics, including institutional economics, is aware of the difficulties of the market exchange of IP but seems to be unable to offer an explanation.

- “The IP market [in the semiconductor industry] cannot be considered within the traditional microeconomic framework where prices result from the simple confrontation between suppliers and customers on the market place.”
(Guilhon/Attia/Rizoulières 2004: 138)
- Not transaction costs but “subtler and harder-to-observe elements such as the inability to find buyers or the difficulty in getting internal approval” prevent licensing ag-

2 The estimation is based on the patent survey in the six aforementioned countries plus Denmark and Hungary, which were added in a second round in 2005. “These countries cover almost 90 percent of the EU-25 patents” (ibid.: 3).

reements from being concluded. “The development and the efficient functioning of markets require supporting institutions” (Gambardella/Giuri/Luzzi 2007: 1180).

These quotations reveal that economics tends to conceive of any commercial transaction as an exchange in a given market place and to regard the occurrence of an exchange as solely contingent on the cost of transaction.

We do not argue that transaction costs are a negligible factor with regard to market exchange or other forms of trade of IP. But conventional economics has serious difficulties addressing other factors which affect IP trade and market emergence unless they can be translated into transaction costs. The sociology of markets tackles those factors which account for the emergence and functioning of markets. A decisive factor relates to uncertainty. It is suggested that a stable system of market exchanges will not emerge unless the contingency and uncertainty in the course of exchange has been reduced to an acceptable level (Beckert 2007).

Below, we take up this suggestion, focusing on patents – a specific legal form of novel codified technological knowledge. Our analysis represents work in progress, building on a yet incomplete review of the pertinent literature and on ten pilot interviews with potential participants in patent trading.³ We claim in this paper that *different facets of uncertainty impede markets for patents to emerge*. In one way or another, uncertainty is related to the novelty of knowledge on the one hand and to its goods characteristics on the other. Elaborating on this argument, we first look at the characteristics of knowledge and the way in which it is transformed into private property and a (fictitious) commodity (section 2). In the next section we briefly discuss the modalities and peculiarities of patent transactions and introduce our concept of markets as institutional fields. Following up on Frank Knight’s notion of uncertainty (section 4), in section 5 we highlight the important sources of fundamental and strategic uncertainty that make it extremely difficult for the potential partners of a transaction to establish the value of a patent. In section 6 we show that some of these difficulties are overcome or coped with at the structural or the strategic level and trade is facilitated. We tentatively conclude in the final section 7 that it would be premature to assume that the market is going to be the prevailing mode of patent trading. While this paper concentrates on the mainly presupposed repercussions of uncertainty on patent trading and market emergence, we expect from our qualitative research project – once it is finished – to offer more general insights into the processes of constructing knowledge-related intangible objects of trade and of constituting markets for these objects. Thus, we address central issues of the sociology of markets and contribute particularly to the neoinstitutional field approach to the emergence of markets (Fourcade 2007: 1022–1024).

3 Two patent managers of a large company and a small subsidiary of a large firm; one patent attorney; one CEO of a small biotech start-up; one CEO of a small venture capital firm; four patent specialists affiliated with different types of intermediaries such as technology transfer units, brokers, and/or consolidators (who purchase patents and assemble them in portfolios which they sell); and, finally, an expert team analyzing the use of patents.

2 Creating property and ownership of technological knowledge

While real property has physical (material) parameters, making it a tangible good, knowledge is intangible. Concerning its goods characteristics, standard economics treats knowledge as a (latent) public good, which is characterized by non-rivalness and non-excludability of use as well as inexhaustibility and infinite expansibility (Nelson 1989). Thus, knowledge has positive externalities but cannot be “over-grazed” or over-used, and no “tragedy of the commons” can occur (cf. Hardin 1968). Moreover, useful knowledge is expensive to invent, but it can be distributed at low marginal cost or diffused by generating technical spillover effects (cf. Foray 2004). As a consequence of these characteristics, problems of “free riding” and underinvestment in knowledge production may arise (cf. Olson 1971). Private investors will not be inclined to invest in the production of knowledge unless they see an opportunity to avoid free riding and earn an adequate return on investment.⁴

An institutional protection of innovative knowledge is provided by its propertization through intellectual property rights (IPR). Patent rights, as a special case of IPR, are registered rights. They allow people to assert ownership rights on the outcomes of their creativity and innovative activity in a way similar, but not identical, to that in which they can own physical property. A patent right is an absolute exploitation right granted by patent offices to inventors or their successors in title for a limited period of time (generally a maximum of 20 years). Patent applicants – when they file the application with the patent office – must disclose the invention “in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art” (Art. 83 European Patent Convention). The patent claim specifies in legal and technical terms what precisely it is for what patent protection is sought. Patents can be granted to individuals, firms, or other entities. Once they have been granted, their content is made available to the public by the patent office. In return for the disclosure, the patent holder (patentee) receives a temporary monopoly right, as only the holder is entitled to make, use, or sell any product that falls under the terms of patent. That means that the patentee has the legal right to exclude others from commercially exploiting the invention but is at the same time entitled to license or sell it to others. By these forms of trade the right to commercially use patented knowledge is shared with others or transferred to them. To the party that acquires a patent or receives a license, the transaction usually embodies an investment expected to pay off in the foreseeable future.

Patent law is national law in principle, yet most essential features are similar or identical in the industrialized world (Mersch 2005). According to the law, patentability requires an invention to be novel, which means that the invention must not have been published anywhere. Minor or trivial improvements in knowledge cannot be patented if they are

4 This point is recurrently raised by owners of intellectual property who call for strong legal protection, but it is increasingly disputed from the perspective of free market entry and competition law and policy (cf. Hilty 2007).

obvious to an expert who is familiar with the state of the prior art. In general, an invention if it is new but not a discovery can be patented. In Europe, another precondition stipulates that an invention shall be considered as “susceptible of industrial application” (Art. 57 European Patent Convention), while in the US the invention merely has to be “useful” (U.S.C. 101 Consolidated Patent Laws). Other differences refer to national patent policies – in particular to the national patent offices’ practices of granting patents.

Although intellectual property cannot be regarded as equal to physical property, the assertion of property rights to knowledge and the assignment of ownership to the inventor is seen to provide economic incentives to create innovative knowledge and – given functioning intellectual property markets – to transfer the rights to those who are prepared to pay the most for them. Appropriability of knowledge is a matter of the efficacy of intellectual property regimes as a legal barrier to replication and imitation (Teece 1998). But even if patentees are assigned legal ownership of their invention, they cannot be sure that competitors do not invent around the patent claim if it is technically feasible and not too costly. Therefore, the ease of inventing around and the amount of information disclosed in a patent application are reasons for not applying for a patent but keeping the invention secret (Cohen/Nelson/Walsh 2000).

But functioning market transactions of intellectual property require that all market actors have access to complete and low-cost information about the existence and the characteristics of patents. This condition is met in principle through the disclosure of all granted patents in patent registers and the information services provided by patent offices and patent information centers. Open and free patent databases such as PATLIB or EPOLINE facilitate investigations into the patent holder, inventor, priority date, opposition proceedings, the patent claim, and further technical descriptions of a patent that are relevant from a technical, legal, and business strategy perspective. This form of revealing knowledge is seen to make trading patents possible and thus to mobilize knowledge which would otherwise remain in the possession of inventors who are not directly interested in seeing their inventions being used by others (David/Foray 2001: 14).

But, as has already been indicated in the introductory section, these expectations are often frustrated. Trading intellectual property is far from functioning without friction. One reason for this may be that the openness and transparency of patent databases is not crucial for facilitating trade. We usually take it for granted that knowledge – in particular, but not exclusively, basic scientific knowledge – is open, produced and distributed through non-market mechanisms, and driven by non-commercial incentives and motives (David 1998; Nelson 2004). This raises doubts that knowledge can be treated as a conventional commodity. Similar to Karl Polanyi’s designation of labor, land, and money, it might be more appropriate to regard knowledge as a “fictitious commodity” (Polanyi 1957: 68–76). Polanyi argues that – in a commercial society with a market economy – labor, land, and money must also be organized in markets, although they are not actually produced in order to be sold and bought and are “obviously not commodities” in this sense (*ibid.*: 72). They are, however, traded on the market, which is

organized as if they were commodities. Emphasizing that commodity fiction is a vital “organizing principle of society,” Polanyi does not explicitly rule out that in complex societies other elements must also be treated as fictitious commodities (ibid.: 75). This prompts the question – explicitly raised by Bob Jessop (2007) – whether, in contemporary market-coordinated knowledge societies, knowledge should be considered a fictitious commodity. Jessop puts forward three arguments supporting this view (Jessop 2007: 117, 118). First, “knowledge production and circulation can be secured otherwise than through market exchange.” University research would be a case in point. Second, while knowledge in the knowledge economy has a price, “it is not produced for sale but is simply a gift of [human] nature.” Third, as the knowledge economy can survive only as part of market society, “knowledge must be priced to ensure a balance in supply and demand.” State politics and patent politics in particular play a crucial role in the commoditization process of knowledge. Since the second half of the 1970s the purview of patentable knowledge has expanded significantly, including the patentability of living forms and in – nationally different variants – also software and business methods. This development has not been uncontested both historically and currently (cf. May/Sell 2006; Werle 2005). Counter-movements such as the open source (Holtgrewe/Werle 2001; Weber 2004) and the creative commons (cf. Lessig 2004) movement as well as ethical controversies regarding the patentability of life provide evidence that there is resistance to commoditization (cf. Fourcade/Healy 2007: 291–295; and, regarding ethics, Jasanoff 2005: 171–224). Notwithstanding the resulting uncertainty and other difficulties in extracting revenue from patents, useful knowledge has assumed the characteristics of a fictitious commodity and a potential source of revenue.⁵

3 Transactions and markets

Patent law specifies the terms on which novel technological knowledge is transformed into property and ownership is assigned. But the law lacks provisions dealing specifically with the peculiarities of the commercial trade of patents. Patents are exchanged via sale or, more frequently, via licensing, provided that they are offered for sale and that there are potential customers. The necessary contractual arrangement between the parties involves either the transfer of ownership from the seller to the buyer (sale) or the permission (license) granted by the owner to a licensee to use the patent for commercial purposes. In any case, the technological knowledge being transferred is appropriated by

5 Lyotard (1984: 4) even goes a step further, arguing that knowledge has become the principle force of production, and “the relationships of the suppliers and users of knowledge to the knowledge they supply and use is now tending, and will increasingly tend, to assume the form already taken by the relationship of commodity producers and consumers to the commodities they produce and consume – that is, the form of value. Knowledge is and will be produced in order to be sold, it is and will be consumed in order to be valorised in a new production: in both cases, the goal is exchange. Knowledge ceases to be an end in itself, it loses its ‘use-value.’”

the purchaser in a decontextualized institutional form of property, which then has to be integrated into a new context.

In the wake of the gradual transition from the industrial era to the knowledge economy, legally protected intellectual property has increasingly been traded both nationally and across borders. Comprehensive data are missing, but surveys in different countries and industries indicate the growing importance of what industrial economics calls the “markets for technology” (Arora/Fosfuri/Gambardella 2001). Using scattered evidence Kamiyama, Sheehan, and Martinez (2006: 16) point out that “markets are large and growing.” They refer to the confidentiality of private contracts and a lack of legal obligations to disclose revenues from pertinent transactions as the main reasons why the empirical basis is weak. Since many OECD countries require that cross-border licensing contracts be reported, time series data are available for this area. They show that in “major OECD regions” receipts for intellectual property (not only patents but also copyrights and trademarks) from international licensing increased from 10 billion USD in 1985 to nearly 110 billion USD in 2004 (ibid.: 17, 18). In 1990, France received 330 million EUR solely from international patent licenses and sales. The receipts rose to 2.4 billion EUR in 2003. In the same time period, Germany doubled its respective revenue from 1.3 to 2.7 billion EUR (ibid.: 18). Most recent figures reported by the German Bundesbank show that in 2005 receipts from international patent licenses and sales amounted to nearly 4.1 billion EUR (Deutsche Bundesbank 2006: 15). As remarkable as these figures on the international trade of patents and other intellectual property are, they need qualification. Most international licensing takes place among affiliated businesses. In 2005, the share of this type of licensing lay well above 50 percent in the major OECD countries (Kamiyama et al. 2006: 19). In Germany it exceeded 90 percent (Deutsche Bundesbank 2006: 23). But such licensing activities cannot be regarded as market exchanges of patents, and it still appears questionable calling them external transactions.

Thus, not every transaction of intellectual property is a market transaction. Propertization of useful new knowledge and the assignment of ownership to an individual or a company in the form of patents is a necessary condition of market exchanges, but it does not suffice for a patent market to emerge (cf. Fligstein 2001: 27–44). Generally, markets do not simply evolve. We regard markets – in accordance with the neoinstitutional field concept – as institutional fields (Aspers/Beckert 2008: 238, 239; Fligstein/Dauter 2007: 112–117). They are established or constituted by producers/sellers and consumers/buyers, intermediaries, and regulators who orient their actions toward each other and to the objects of trade – in our case intellectual property (cf. DiMaggio/Powell 1991: 64, 65). A set of shared formal and informal rules, standards, conventions, and norms governs cooperation and competition and the way transactions are carried out. The market’s cognitive framework, which may include knowledge provided by industrial and managerial economics (cf. MacKenzie 2007), creates awareness of trade and profit opportunities and guides the (potential) market actors’ strategies. In new or emerging markets, many elements of the cognitive framework are not random but shaped by the

actors who enter the market and often emulate neighboring markets (Fligstein 1996: 665). In such an institutional field the products to be traded are collectively defined, and exchange is facilitated.

4 Uncertainty

According to neoclassical economics, the efficient functioning of a market requires transparency, homogeneity of goods, and complete information on the side of the actors involved in transactions. In such a market, economic risks do not exist or are easy to calculate and absorb. Under these circumstances, actors can anticipate the outcome of their decisions and rationally allocate resources to achieve the most preferred outcome. But these conditions are rarely, if at all, realized. The modern dynamic economy is characterized by complex interdependencies and constant changes of both the terms and the circumstances of exchange. Technical and institutional innovations continuously alter market processes and structures. Thus, economic action often engenders unintended and unexpected consequences, and economic relations are generally characterized by uncertainty of outcomes. Primarily, it is not the actors' limited cognitive capacity but rather the situational structure that is the source of uncertainty (Beckert 1996: 821).

Following the seminal work of Frank Knight (2002 [1921]), uncertainty must be distinguished from risk. While risk relates to outcomes of economic action to which probabilities can be assigned, uncertainty alludes to situations in which information on which probability calculations could be based is lacking. The concept of uncertainty has been further specified and differentiated in the literature. In the context of this article, two types are particularly relevant. One type is fundamental or substantive uncertainty. Here the actors lack all information necessary to make decisions with predictable outcomes, and this information is unavailable, even in principle, at the time when the decision is to be made (Dosi/Egidi 1991). The other type is strategic uncertainty (Schelling 1960). It relates to situations of asymmetric information. Here some actors hold information which is unavailable to others (Akerlof 1970). This can elicit moral hazard and other forms of defective action. In game-theoretic terms, the players – who are interdependent with respect to the outcome of interaction – are caught up in a game of incomplete information and, accordingly, lack knowledge about the strategies of other players.

From the angle of a functioning market exchange of goods, uncertainty has detrimental effects unless “expectational structures” and “social devices” emerge which help cope with uncertainty in decision-making processes (Beckert 1996: 827).

5 Sources of uncertainty

In what follows, a few sources of uncertainty regarding a patent's value and its tradability are highlighted. We start with sources that allude to fundamental uncertainty. They relate to the process of research and development (R&D), the uniqueness of a patented invention, the projection of demand, and the valuation of a patent.

To begin a process of research and development means embarking on a journey with a highly uncertain outcome (Machlup 1984: 169). "The 'best' way to proceed is seldom apparent" to the firm or other innovators (Van de Ven et al. 1999: 170) and "output can never be predicted perfectly from the inputs" (Arrow 1985: 111). Thus, innovative efforts may fail or produce inventions which are not exactly the ones sought.⁶ Moreover, their novelty may be contentious and their patentability insecure. Only when a patent has been granted is private ownership of intellectual property in the respective technical knowledge constituted and legal protection from infringement formally guaranteed. But gaining returns from innovation is not primarily a matter of establishing a patent (Nelson 1989: 235). It also depends on how the patent is used. It can be used for different purposes or even left unused, as we have already seen.

If the owners consider offering a patent for sale or licensing it, they must ascertain a demand for the patent. This may turn out to be as difficult as projecting the sales volume of a new product or service based on the patent, especially if the patented knowledge has not been translated into a working prototype of a technology (cf. Arthur 2007). The more radical the innovation, the less predictable is the demand for and the commercial success of the innovation.

Linked to the question of demand is the issue of establishing the value and eventually setting the price of a patent. Certainly, the patent's value is not a fixed parameter. An important factor which affects the establishment of value is the intended utilization of the patent (cf. Hall/Ziedonis 2001). It makes a difference whether a patent is seen by its owner as a means to exclude potential competitors from the market and obtain a monopoly price for the patented product (monopoly value) or as a bundle of pieces of technical knowledge that are to be sold or licensed (trade value). Again, different values will be assigned if the use of a patent aims to acquire capital through, say, a bank loan (asset value) or to facilitate blocking innovative activities of other firms (blocking value).

Only selling patents or granting licenses represent direct commercial transactions of intellectual property. But concentrating on these modes of trade does not necessarily reduce uncertainty and volatility as regards establishing the value of patents. Business

6 According to the respondents of the PatVal study, 37 percent of the patents embodied the targeted achievement of a research project, and another 11 percent were "expected" by-products of a project (PatVal-EU Project – Gambardella 2005: Appendix Table D.31).

management literature dealing with transaction-oriented methods of patent valuation offers little help, as it struggles with the same phenomenon that confronts the actors involved in potential transactions: namely the uniqueness of a patent (Granstrand 2000: 80) and the difficulty constructing comparability with other objects – an elementary precondition to establishing the trade value of patents (cf. Beunza/Stark 2004; also Smith 1990: 21–50). Cost, market, and income approaches to the value of patents prevail in the literature, but each of them comes in several different variants.⁷ As a consequence, none of them represents the standard valuation method which would help the actors to cope with uncertainty. Instead, it is acknowledged that in reality “the value of a patent is ultimately subjective” (Perez Pugatch 2004: 3) – a matter of rules of thumb or just feeling and instinct (Clarkson 2001).⁸

When transactions of patented knowledge are considered or initiated, fundamental uncertainty is accompanied by strategic uncertainty. A patent’s trade value is established not only by the seller but also by the potential buyers. They are confronted with some of the facets of uncertainty in much the same way as the seller but they tackle them from a different perspective. Being less affected, but not unaffected, by the vicissitudes of the process of research and early development of technology, they are closer to the market of an innovation and have to figure out its sales prospects. One can by no means expect these prospects to be favorable simply because a license grants to the licensee the right to use the acquired knowledge for commercial purposes. Transforming patented knowledge into tradable goods often means that there is still a long and uncertain way to go. As a result, the potential purchaser of a patent or a license has difficulties in judging its value in advance. The seller would face a similar problem if they wanted to keep the patent and develop a tradable product.

But the purchaser’s problem is aggravated by information asymmetries vis-à-vis the patent owner, whose knowledge exceeds that which is laid down in the patent specification, while the potential buyers have little information regarding the “quality” of the patent (Bessen 2006: 22). Even though information asymmetry is a source of strategic uncertainty, it does not imply that the patent owner withholds knowledge consciously. It only indicates that complete appropriation of knowledge by third parties is severely constrained (Arrow 1985; Machlup 1984: 182–185; Hayek 1945: 521, 522). Although a patent contains knowledge in codified form, which in principle facilitates its transfer, it

7 The cost approach calculates the total costs of developing and patenting new knowledge (retrospective); the market approach makes comparisons with recent real market transactions involving functionally similar patents; the income approach calculates future income derived from successful utilization of patented knowledge through a discounted cash flow analysis or a real-option based approach (prospective).

8 For other, non-transaction-oriented measures, different properties of the patents serve as indicators of their value or quality (Harhoff/Scherer/Vopel 2003; Reitzig 2003). The indicators include the scope of the claims, the number of countries in which an invention is patented (family size), the citations a patent receives, or the duration of a patent’s validity (cf. PatVal-EU Project – Gambardella 2005).

does not communicate the context in which the knowledge has been generated and has partly remained tacit (Howells 1996; cf. Zucker/Darby/Brewer 1998). Additionally, the information included in the patent claim is “sticky” (von Hippel 1998), often involving vast amounts of technical data and complicated formulas. Thus, equipped only with the technical description of a patent, it is difficult to imagine the final product and its target market, not to mention the patent’s value (cf. Stehr 2002: 55–57). For that reason, the purchaser will need to acquire complementary know-how from the patentee (Clarkson 2001: 6). Usually this know-how is secret or, at least, not codified and legally protected, and hence difficult to appropriate (cf. Aspers 2007b).

Another facet of strategic uncertainty confronts potential seller and buyer alike. It relates to the patent as a legal construct. Such an entitlement promises security, which may be no more than a fiction. A patent owner’s legal protection from infringement is formally guaranteed, but no enforcement agency exists to monitor the use and abuse of patented knowledge. Patent infringement must be detected and, if necessary, legally pursued by the patentee, and damages or other sanctions can only be imposed by the courts. While a patent owner or a licensee may bring a court action for infringement, an alleged infringer or a competitor of the patentee may respond with a patent invalidity suit. As a result, uncertainty increases over the validity and tradability of a patent. Conversely – as is suggested by studies of IPR enforcement – competition for the use of patented knowledge including patent litigation signals that a patent is valuable and that its protection is associated with the presence of potential users of the underlying knowledge (Lanjouw 1992; Lanjouw/Lerner 1998: 237–244; Sherry/Teece 2004).

6 Coping with uncertainty

As we have seen, trading patents is laden with uncertainties, fundamental as well as strategic. They explain why patent transactions cannot be analyzed using the tools of standard microeconomics. Here markets are defined as abstract spaces where given products are exchanged among competing anonymous agents (Coriat/Weinstein 2004: 49). With patent transactions, however, the product is not given but must be treated as an “economic variable” (Chamberlin 1953; also Callon/Méadel/Rabeharisoa 2002: 197–202). Thus, rather than simply exchanging ownership of a well-defined object, involving oneself in the transaction of patented knowledge means entering a process in which few actors collectively define and construct the object being exchanged (cf. Coriat/Weinstein 2004: 47). According to our concept of a market as an institutional field, this process involves sellers, buyers, intermediaries, and occasionally regulators too, including the courts. They simultaneously interpret and shape the cognitive and normative framework that helps the actors to define the product to be traded and the terms of transaction.

We can observe developments at both the structural and the strategic level of the institutional field which facilitate coping with uncertainty (cf. Lichtenthaler 2005: 236–238). In order to initiate collective construction of the product that is to be traded and prepare for the exchange of this product, supply and demand must be brought together. Our pilot study suggests that patent transactions are usually initiated by the patent owners, occasionally asked to do so and assisted by intermediaries. Although the supply side prevails, intermediary organizations play a vital role (cf. Hoppe/Ozdenoren 2005). Using their particular technical, legal, and commercial expertise and their knowledge of supply and demand, they strive to arrange transactions. In a position as relatively neutral third parties, they provide decisive information to the potential transaction partners regarding the use options and the exchange value of a patent. More often than not, they apply valuation methods which they have developed on the basis of experience and data gathered in previous transactions. Provision of – in this sense – accurate information increases credibility and concomitantly the reputation of the intermediary. This again helps to reduce uncertainty. There are different types of intermediaries. Not all of them restrict their role to brokering patents. Some also act as consolidators who purchase selected patents (often with low stand-alone value) and assemble them in packages (portfolios) which they offer for sale or licensing. To demonstrate the value of their patent portfolios and improve the sales prospects, they occasionally produce a prototype of the new technology. Thus, consolidators add value to the patents but risk their reputation as neutral intermediaries.

The more the intermediaries exclusively specialize in patent trading, the more they are confronted with the uncertainty that weighs on this business. Conversely, their existence and commercial well-being is directly dependent on this uncertainty. Without uncertainty intermediaries would not be needed – with too much uncertainty they would not survive. This may be one reason why some specialized intermediaries in Germany also act as “institutional entrepreneurs” (Beckert 1999) trying to influence public policy and informal processes of institution building that seek to reduce uncertainty.

The emergence of intermediaries is not the only structural feature which promotes the trade of patents. The growing number of firms, mainly start-ups specializing solely in creating, patenting, and licensing new useful technical knowledge (Davis 2006), is also noteworthy. They can only exist if they possess the know-how required to identify potential customers and accordingly align and fine-tune their R&D endeavors. More prevalent is the tendency of large and medium-sized firms to establish intellectual property (IP) units or divisions and to create positions of IP managers and/or IP executives (Arora/Fosfuri/Gambardella 2001: 238–239). Managers in such specialized roles routinely treat patents as assets that can be traded to generate revenue. They continuously collect information concerning potential demand for patents by other firms in the respective industry or in technologically proximate sectors (Guilhon/Attia/Rizoulières 2004). Increasingly they also scour the landscape of knowledge producers for patent acquisitions. Our pilot study suggests that information is exchanged in networks of IP

managers. They directly get in touch with their colleagues in other firms to offer for sale new knowledge that either lies outside their organizations' core business or is under-utilized.

At the level of actors' strategies, we also find distinct elements designed to cope with uncertainty. Once purchaser and seller show interest in a transaction, the former will proactively request detailed information about the patented knowledge and essential complementary know-how in order to assess the risk of the transaction. A letter of intent or some kind of provisional contract ascertains that both sides are seriously interested in concluding the transaction. This helps create an atmosphere of trust and prevents, but does not totally rule out, defective action (Möllering 2008: 13–15). It facilitates what the actors call "due diligence." Due diligence is a routine practice with mergers and acquisitions. It covers the process of contacting, gathering information, and auditing the object of purchase with a view to concluding an agreement for sale (e.g. Parr 2006). As with mergers and acquisitions, in the case of patent transactions "rigorous and informed due diligence of IP assets" is advised (Rivette/Kline 2000: 169). One central aspect of this procedure is that it obliges the patentee to provide all the available information the purchaser asks for. In return, the recipient is committed not to use the information or communicate it to third parties if no agreement concerning the transaction has been reached. The due diligence principle is widely accepted by companies and by courts alike. It appears to be a necessary basis for the conclusion of many patent sale or licensing agreements.

In most transactions, licensing agreements are preferred to on-the-spot sales. One repeatedly controversial issue in license negotiations concerns the methods of calculating the value of a patent (cf. Callon/Muniesa 2005: 1239). Whether or not a compromise can be reached often depends on the results of the actors' endeavors to create mutual commitment. Commitment on the side of the patentee concerning the commercial success of the licensed knowledge can be assured if upfront payments by the licensee (at the time when the contract is concluded) remain low whereas royalties based on the future sales volume of the new product are relatively high and guaranteed for a comparatively long period of time. Often, additional service and collaborative agreements are negotiated, stipulating, for instance, that the patent owner's complementary knowledge, including tacit knowledge and know-how which the patent specification does not contain, is transferred to the licensee. Some contracts also include arrangements about further development of the patented knowledge and shared ownership of emerging new knowledge and the resulting financial revenue. Generally, licensing agreements are complex. They are composed of several sub-contracts including the actual patent license contract, but also, as indicated, other agreements such as disclosure and transfer of know-how, collaborative technical development and, particularly noteworthy, arbitration agreements in case conflicts arise while the contract is being completed.

An international survey has estimated that about 50 percent of all licensing agreements are of this comparatively complex kind (Brousseau/Chasserant/Bessy 2005: 19). This

underpins the singularity of many patent transactions, which obviously go beyond the mere exchange of knowledge laid down in the patent specification. The concomitant licensing agreements appear to be more than solely a means to reduce strategic uncertainty by establishing legally binding commitments. In the course of the negotiations a complex object of exchange is constructed, and in this context the value of a patent is established. Often the agreements are the starting point for ongoing collaboration and an emerging atmosphere of trust and sharing between the transaction partners. This may justify investing a good deal of time and other resources in such agreements.

But even if – in anticipation of potential conflicts and frustrated expectations – the contracting parties agree on provisions to deal with these and other problems, they are unable to control all possible risks, respond appropriately to still unknown changing conditions, and overcome all facets of strategic uncertainty (Scott 2006). The contracts remain basically incomplete (Teece 1988).⁹ This indicates that, despite all the options for coping with uncertainty, trading patents continues to be cumbersome. What is known about the actual practice of patent trading suggests that the safest and the most preferred way of doing business is “to limit technology transfers to the firm’s partners, i.e. organizations with which the firm has already interacted in the past.” Bidault and Fischer (1994: 373) arrive at this conclusion from a small survey of 31, mostly French, firms (licensor and/or licensees) in the early 1990s. The authors stress that successful transactions typically take place between firms who enjoyed business relationships before entering into license negotiations.¹⁰ The OECD data showing that most international licensing takes place among affiliated businesses corroborate this point (see above section 3). From this perspective, vertical and horizontal integration of firms via mergers and acquisitions still appear as viable options for bypassing market exchange and avoiding some of the inherent problems of incomplete contracts (Teece 1988).

But in line with Granovetter’s embeddedness argument there are also other ways to facilitate transactions (Granovetter 1985: 490 pp.). We mentioned a firm’s propensity to do business with firms they know from earlier deals. In a recent study of 152 firms across industries, Lichtenthaler and Ernst (2007: 37, 41) arrive at the conclusion that in order to “overcome the imperfections in the knowledge market” and facilitate licensing, suppliers actively develop reputation. Reputation then may render complex formal licensing agreements unnecessary. Bidault and Fischer (1994: 373) even go a step further, arguing that “the identity of the partner may actually matter more than the technology being traded.” These findings suggest that, even though acquiring a patent or a license

9 In Germany, the contracting parties are additionally confronted with an inherent legal uncertainty resulting from the fact that a license contract embodies a contract *sui generis* (Groß 2007). Therefore the outcome of a lawsuit is particularly difficult to judge.

10 An analysis by Anand and Khanna (2000: 114 ff.) of 1612 licensing deals with at least one US partner (also in the early 1990s) qualifies Bidault and Fischer’s findings. In this study, less than 40 percent of the firms which signed licensing contracts had prior relationships. Institutional diversity of the kind emphasized in the varieties of capitalism literature may account for the difference (cf. Hall/Soskice 2001).

to use patented knowledge is usually regarded as an investment, the process of value assignment is akin to what has been observed in saturated consumer markets where the status of sellers and buyers can be decisive for determining the price of a transaction (Aspers 2007a: 384–387). Joel Podolny (2005: 18) relates the status argument directly to the issue of uncertainty when he claims that the greater the uncertainty about the quality of a product is, the more the potential buyer will rely on the seller's status to make inferences about quality.¹¹ Thus status orientation as a way of coping with uncertainty must also be considered when the factors facilitating patent trading are analyzed.

7 A market for patents?

Fundamental and strategic uncertainty related to patent trading – a specific decontextualized institutional form of knowledge property – has prevented functioning markets for patents from emerging. Apparently, patent transactions are not made in perfect, anonymous neoclassical markets. Also, if we define markets less rigidly as institutional fields constituted by sellers and buyers, intermediaries and regulators, sharing rules, standards, and norms which govern transactions, we can hardly speak of a market for patents. But the number of intermediaries is growing, as is the propensity of firms to employ specialized intellectual property professionals. These and other actors potentially involved in patent transactions gain trading experience, experiment with different modes of trade, and invent ways to cope with uncertainty. Licensing contracts between the patent owner and the licensee of technological knowledge are crucial here. These often rather complex contracts and the concomitant negotiations help to establish mutual commitment as regards the transformation of patented and complementary knowledge into a final marketable product. Therefore, licensing agreements and the collective construction of the product to be traded can be the starting point for long-term collaboration between actors who did not even know each other before. Yet the considerably high share of patent transactions between affiliated firms and those which had prior relations suggests that a generally accepted licensing regime has not been established.

Governments and regulators, including the courts, have mainly been involved in generally expanding and strengthening the appropriability of new useful knowledge rather than providing responses to the inherent uncertainty of patent trading. Bottom-up and public-private initiatives – such as seminars and workshops intended to create awareness that patents are a worthy object of trade and to strengthen expertise among business managers, lawyers, and other professionals – seem to be more appropriate at ad-

11 Podolny also analyzes the influence of status in the process of technical invention. Focusing on the semiconductor industry, he shows that status acts as a “signal of invention quality in the technological domain, just as ... it acts as a signal of product quality in the market domain” (Podolny 2005: 160).

addressing uncertainty. The initiatives include regime-building efforts at the international level, where a professional non-governmental association, the Licensing Executives Society International, has started to review and assess licensing practices in different countries (Brousseau/Chasserant/Bessy 2005; also Razgaitis 2007). Other efforts aim at developing generally accepted methods for patent valuation. Certain patent offices, along with the International Standardization Organization, are either active here or are considering becoming active. These and other developments may justify designating patent trading as an emerging market. But it remains an open question whether, in the future, the market will be the predominant mode of patent trading in the knowledge economy.

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