The EU-Directive on the Legal Protection of Databases and the Incentives to Update: An Economic Analysis

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Abstract

The database directive, initiated by the European Commission in 1992 and due to be finalised in the near future, establishes a two-tiered system of protection, amending copyright with a *sui generis* rule that grants protection against unfair extraction. The terms of protection are extended if the producter makes „substantial changes" to update the database. This paper analyses the incentive to update created by the database directive. In contrast to the usual findings of the literature on the incentive effects of intellectual property rights, we find that, although in most cases the incentives to update a database are insufficient from society's point of view, the possibility of extending the term of protection by making 'substantial changes' in the database may create an *incentive for excessive updating*. This leads to conclusions about what should be considered a substantial change

Zusammenfassung

Die in Datenbank-Direktive, deren endgültige Fassung in Kürze vorliegen wird, garantiert Datanbankproduzenten einen zweistufigen Schutz: Neben dem Urheberrecht existier ein *sui generis* Recht das vor unlauteren Auszügen schützt und dessen Schutzdauer sich verlängert, wenn der Produzent die Datenbank durch substantielle Änderungen aktualisiert. Dieses Papier befaßt sich mit den Anreizen zur Aktualisierung. Im Gegensatz zu den üblichen Anreizwirkungen von Rechten zum Schutz geistigen Eigentums ergibt sich hier ein Anreiz zu exzessiven Investitionen in die Aktualisierung von Datenbanken. Produzenten nehmen Aktualisierungen auch dann vor, wenn dies gesamtgesellschaftlich nicht wünschenswert ist. Aus dieser Erkenntnis ergeben sich Folgerungen für die Festlegung dessen, was als substantielle Änderung gelten sollte.

JEL-Klassifikation: *K11, K19*

Encyclopedia of Law and Economics: *1600, 1610, 1640*

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1. Databases and Copyright

In 1992 the European Commission issued a directive on the legal protection of databases (OJ No. C 156, 1992), which was amended by the Commission in 1993 (OJ No. C 308, 1993). The database directive was, in principle, adopted by the Council in July 1995 (Common position no 20/95, OJ No. C 288, 1995) and is still subject to final approval by the European Parliament which is expected to propose only minor changes and amendments.

The database directive establishes a two-tiered system of protection: databases shall be protected under copyright or, if the collection of data does not constitute an intellectual creation, under a *sui generis* rule that grants protection against unfair extraction.

This proposal for a directive can be seen as a further development in the European policy to extend and harmonise copyright protection throughout the community.[1] Databases are regarded as a „... vital tool in the development of an information market within the Community; whereas this tool will also be of use in many other fields" (Recital 9).[2]

Since the „... database manufacture requires the investment of considerable human, technical and financial resources while such databases can be copied or accessed at a fraction of the cost needed to develop them independently" (Recital 7), the rights of authors of databases have to be explicitly protected by the law to provide incentives to create databases.

Databases, however, are different from most other forms of intellectual property insofar as a collection of information intended to be used to ease the retrieval of information gathering will possibly lose its value if it is not updated.[3] Consider, for example, a database containing legal provisions and court decisions that is used by lawyers for retrieving all available information concerning one specific legal case. Unless new pieces of legislation and new court rulings are added continuously, this database loses its value as a source of reference and is eventually of interest only to scholars of legal history. To prevent the valuation for his product from decreasing, the supplier of database services, therefore, not only has to incur the costs of creating the database in the first place, but also the costs necessary to update the database continuously.

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1 Another example for the extension of copyright protection to include new information goods can be seen in the adoption of a directive on the legal protection of computer programs (OJ No. L 122, 1991).

2 All quotations from the database directive are taken from the Common position (OJ No. C 288, 1995).

3 Note that this feature is typical for almost all collections of data, and as such even for e.g. road maps, railway time-tables or the *Guide Michelin*. Thus, the use of the term „database" should not lead to the misperception that the problems addressed in this paper are specific to electronically stored data.

This paper will analyse to what extent the legal protection of databases can create an incentive to update the database. The proposed directive explicitly aims at an incentive for the creation of databases and the provision of database services, because „... an investment in modern information storage and retrieval systems will not take place ... unless a stable and uniform legal protection regime is introduced for the protection of the rights of database manufacturers“ (Recital 12). We will ask how the decision to update a database depends on the extent to which the producer can claim property rights to the database.

Furthermore, we address the question of whether the incentive of legal protection given to the producers of databases actually guarantees that databases are updated whenever it is socially optimal to do so. In contrast to the usual findings of the literature on the incentive effects of intellectual property rights, we find that, although in most cases the incentives to update a database are insufficient from society's point of view, the possibility of extending the term of protection by making 'substantial changes' in the database may create an *incentive for excessive updating*. Since the supplier of database services can induce a rent-shift from consumer surplus to producer profits if the term of protection is renewed, he may have an incentive to update even if it is not socially optimal to do so.

Section 2 summarises the proposal concerning the scope of protection and relates these provisions to the updating decision. In section 3 we will analyse how the decision to update a database depends on the legal provisions governing the protection of the database. Section 4 recapitulates the results with respect to the proposed directive. Section 5 concludes with some remarks on a potential extension of the analysis.

2. The Proposed Directive on the Legal Protection of Databases and Updating

The proposed directive applies to databases which are defined as "... collection of works, data or other independent materials arranged in a systematic or methodical way and capable of being accessed by electronic or other means." (Art. 1, 2) and excludes "... computer programs used in the manufacture or operation of databases which can be accessed by electronic means." (Art. 1, 3).[4] Member states are required to grant copyright protection to databases which "by reason of the selection or arrangement of their contents, constitute the author's own intellectual creation..." (Art. 3, 1).[5]

If a database is not eligible for protection under copyright, i.e. if the collection does not constitute an intellectual creation, the directive obliges Member States to „... provide for a right for the maker of a database which shows that there has been qualitatively and/or quantitatively a substantial investment in either the obtaining, verification or presentation of the contents, to prevent acts of extraction and/or or re-utilization of the whole or of substantial parts, evaluated qualitatively and/or quantitatively, of the contents of that database." (Art. 7, 1)

Thereby, the Directive requires the creation of a *sui generis* right against unauthorised extraction and/or re-utilisation which is intended to "safeguard the position of makers of databases against misappropriation of the results of the financial and professional investment incurred in obtaining and collecting the contents by providing that certain acts done by the user or a competitor in relation to ... a database are subject to restriction" (Recital 39). This *sui generis* right „is not to be considered in any way as an extension of copyright protection to mere facts of data" (Recital 45). Unlike copyright, it is not granted to the author of a database but rather its maker who is defined as "the person who takes the initiative and the risk of investing" which "excludes subcontractors in particular from the definition of maker" (Recital 41).[6]

The creation of a right to prevent unauthorised extraction follows from the recognition that even the mere collection of data, facts, or statistical

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4 Somewhat inconsistently, however, "protection under this Directive may also apply to the materials necessary for the operation or consultation of certain databases such as the thesaurus and indexation systems" (Recital 20).

5 One problem with the legal protection of databases is the possible conflict between the copyright in the database and copyrights in the works or materials that are incorporated into the database. This possible conflict of legal claims from copyright protection, however, shall be neglected for the purposes of this paper. The reader is referred to legal analyses of the proposed directive (see, among others, Röttinger, 1992, Hoebbel, 1993 or Heker, 1993).

6 Thus, copyright in a database and the *sui generis* right can be vested in different persons, which may create legal problems. For an extensive evaluation of the database directive from a legal perspective see Downing (1996`).

information that will be of value to potential users will require both the investment of a considerable effort, and human, technical and financial resources (cf. Röttinger, 1992, p. 598). Unless it constitutes an author's own intellectual creation, however, such a collection would not be eligible for copyright protection.

Consider, for example, a telephone directory. The creative effort to compile the necessary information is close to zero. The directory should be complete, such that the selection of telephone customers to be included cannot be seen as a form of creative expression, and the way the data are ordered should be clear from alphabetical convention. Nonetheless, compiling all the data necessary to create a complete and ordered directory of customers of a telephone network from scratch may require a considerable investment.[7]

The reason for creating a new right besides copyright can be found in the fact that „... in the absence of a harmonized system of unfair competition legislation or of case-law in the Member States, other measures are required to prevent unfair extraction and re-utilization of the contents of a database" (Recital 6)[8].

While the original and amended drafts had addressed the question of compulsory licensing of the *sui generis* right (which may be one reason why the *sui generis* right does not apply to databases for which copyright protection has been obtained), the Common position does not deal with compulsory licenses. Rather, "protection by the sui generis right must not be afforded in such a way as to facilitate abuses of a dominant position, in particular as regards the creation and distribution of new products..." and "therefore, the provisions of this Directive are without prejudice to the application of Community or national rules of competition" (Recital 47).[9]

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7 This is true even for the compilation of already existing data and their transfer to another medium. For example, Pro CD, a Massachusetts based company, sells data-storing compact discs „which carry the names, addresses and numbers of all 83 m telephone subscribers in America. ProCD's digital directory costs $299; the firm has 250,000 customers. ... Pro CD spends over $100,000 to acquire some 5,000 telephone directories, both yellow and white pages, from all 1,250 American telephone companies. ... Pro CD ships them to Beijing, ... The books are torn up and individual pages are passed to workers trained to regognise Roman characters (and paid $2,000 a year - twice the salary of a university professor in China). ... In America, Pro CD's legal position is clear. The federal courts have ruled that bare list of names, numbers or business categories lack the creative content necessary for copyright protection. ... In Britain, for which Pro CD is developing a compact disc ... the law is different. The 'skill and labour' that BT, which sells its own annual CD directory at £299 ($465), puts into compiling its lists is enough to ensure that it retains copyright." (The Economist, January 14th - 20th 1995, p. 83)

8 For a general analysis of the legal protection of databases by means of copyright or laws against unfair competition see Hackemmann (1987), Scheller (1988), Mehrings (1989), Hillig (1992) or Katzenberger (1992).

9 The explicit reference to competition law, in particular Art. 86 of the EU Treaty, may reflect the impact of the ECJ's ruling in *Magill*, where the refusal to licence information was found to constitute an abuse of a dominant position.

The terms of protection for databases protected by copyright are implicitly defined by the Protection Directive (Council Directive 93/98, OJ No. L 290/9, 1993 - 70 years after the death of the author). The *sui generis* right „shall run from the date of completion of the making of the database. It shall expire fifteen years from the first of January of the year following the date of completion" (Art. 10,1) or "fifteen years from the first of January of the year following the date when the database was first made available to the public" (Art. 10, 2) in cases where a database has been made available to the public before the expiry of the period for which it is protected according to Art. 10, 1.[10]

While the limitation of copyright protection may not be considered an effective limitation because the lifetime of a database (i.e. the time for which the database services are in demand) will most likely be less than the term of protection, the limitation of the right to prevent unfair extraction to 15 years may be relevant for the producer if the lifetime of his database exceeds the term of protection.

This limit in the term of protection may have an influence on the decision to update the database, for example if the updating costs are not covered by the revenues from the sale of database services that the producer could obtain without being able to prevent unauthorised extraction. If 'copiers' can extract data from the original database for the purpose of building their own database to compete with the producer of the original database, then they can offer their database services at a lower price which puts the producer of the original database under competitive pressure.

The producer of the database, however, can extend the term of protection by making 'substantial changes': "Any substantial change, evaluated qualitatively or quantitatively, to the contents of a database, including any substantial change resulting from the accumulation of successive additions, deletions or alterations, which would result in the database being considered to be a substantial new investment, evaluated qualitatively or quantitatively, shall qualify the database resulting from that investment for its own term of protection." (Art. 10, 3) In other words, by continuing to invest in the database, the maker of this database can extend the protection if his investment is found to constitute a substantial change.

In the following section we analyse the impact of the proposed form of protection on the producer's decision to update the database, where this updating

- requires effort and the use of resources by the producer;

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10 This term has been extended by the amended proposal (OJ No. C 308, 1993) and the extension has been upheld in the Common position. The original proposal limited the right to prevent unauthorised extraction to 10 years (cf. Art. 9, 3 of the original proposal, OJ No. C 156).

- preserves the value users place on the database, thus protecting the database from 'depreciation'; and
- gives rise to a fresh term of protection if it qualifies as a 'substantial change'.

3. An analysis of the incentives for updating databases

Having identified the updating issue as the main difference between databases and other forms of intellectual property, we now look at the incentives for updating a database under different assumptions about the extent to which the producer of the database can claim property rights.

The producer sets a price that maximises his profit from the sale of database services, given the variable cost of distributing database services, the (potential) competition by copiers of his database[11], and the (total) demand of users for database services. If copiers compete with the original producer, they offer database services at a price that equals their long run marginal cost.

With free entry of copiers into the market, this price can be assumed to equal the minimum average cost of copiers, denoted as k. If copying itself is costly, this minimum average cost is above the marginal cost of serving an additional user with database services[12]. We can assume this marginal cost of providing users with database services to be equal for the original producer and the copiers. Therefore, with the marginal cost of providing database services equal to c, the price charged for database services under competition from copiers is equal to $k > c$. For the sake of simplicity, we normalise c to zero in our subsequent analysis.

For the analysis of legal protection of databases we have to consider different scenarios. Limited protection, comparable to the usual copyright framework, can be modelled as a situation where the producer is free from the threat of copiers only in the period in which the database has been produced, but not in any subsequent period. The possibility for extending protection by

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11 We will assume that database services are heterogenous. Thus, specific database services can be obtained only from either the producer of this database or copiers of exactly this database. Of course, different databases may be close substitutes, such that producers of different databases face a situation of monopolistic competition. Even in this case, however, every producer of databases faces a downward sloping demand curve for database services. This is a necessary assumption for the subsequent analysis (although the price elasticity may be very high if close substitutes for a specific database are offered by other suppliers).

12 The costs of copying may entail the cost of building one's own system for retrieving the information. Consider the case of copiers who extract data from a database. To supply database services on their own to potential users, they have to incorporate this data in their own information retrieval system, because the basic data obtained by extraction from a database are not the same as a database. For further discussion see Röttinger (1992, p. 598), who compares data with raw materials that have to be transformed into a database to yield marketable services.

updating the database will be captured by modelling an additional period of protection conditional on the decision to update the database.

Let $x(p)$ denote the per-period demand for database services depending on the price charged per unit[13] for an up-to-date database. The corresponding inverse demand function is denoted by $p(x)$. A database is defined to be up-to-date in the period in which it is produced (from scratch).

We will assume that the value of databases for their users declines without updating, and that by updating the producer can prevent this decrease.[14] Let γ denote the fraction of the valuation of an out-of-date database such that the inverse demand functions for an out-of-date database, depending on the amount spent on updating, can be written as $p^o(x) = \gamma p(x)$.

We will assume that the valuation of an updated database can never be higher than the valuation of a database that has been produced from scratch, such that $0 \leq \gamma \leq 1$.

The cost of updating the database is denoted by $U \geq 0$. Updating should never be more expensive than producing the database from scratch (compiling the information, developing an appropriate information retrieval system, etc.) which will be denoted by F (with $U \leq F$).[15]

If the producer is the only supplier of database services and is not threatened by (potential) competition from copiers[16], he will serve users up to the point where marginal revenue equals marginal cost.

With c normalised to zero, the producer sells the monopoly output $x_m = x_m{}^o$ for both an up-to-date and an out-of-date database.[17] Accordingly, prices are

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13 The notion of a 'unit' may be ambiguous, depending on whether the user is charged a fixed amount regardless of the intensity of his use (as in the case of databases sold on CD-ROM or on-line databases with a fix access charge) or whether the charge depends on the amount of data retrieved or the time spent using the database (as in the case of some on-line services). Of course, also a combination of a fixed access charge and a varriable charge depending on the intensity of use is possible. While for our purpose these different ways of charging for database services can be neglected, it is important to note that they can be used to price discriminate between different types of users.

14 Of course, „updating" a database is hardly ever a discrete choice, but should be measured as a continuous process of replacing parts of and amending the database. In this respect, the question of the optimum time path of updating arises in addition to the question of how much the producer should and will spend on updating. For the sake of simplicity, we assume that the decision of whether to update can be modelled as a discrete choice. This restrictive assumption will not be crucial as long as the optimum "size" of the individual updating activities can be determined independently of the timing of updates. An interesting extension of the model presented in this paper, however, could allow for partial as well as delayed update, and, thus, treat the decision on the timing of updating and the size of individual updates interdependently.

15 The difference between F and U expresses the cost advantage of the original producer relative to another producer who would have to produce the database from scratch.

16 This is to say that if copying the database is prohibited by the law and the law is perfectly enforced, or if copying the database is too expensive for copiers to be able to serve the market at a price below the monopoly price set by the original produer.

equal to p_m for an up-to-date database and equal to $p_m^o = \gamma p_m$ for a database that has not been updated. Revenue (or gross profit) from the sale of database services will be denoted by π_m and $\pi_m^o = \gamma\pi_m$, respectively.

In the case where the producer is effectively threatened by competition from copiers (in the case where copying is not effectively ruled out by law and $k < p_m$ or $k < \gamma p_m$, he will set a price equal to k (Bertrand-price)[18]

The number of users buying database services is x_k or x_k^o, both of which are larger than x_m, and revenues from the sale of database services will be denoted by π_k and π_k^o, respectively.

We now turn to the consumer surplus in each case. If the producer sets the monopoly price, consumer surplus S is S_m and $S_m^o = \gamma S_m$ respectively. In the case of Bertrand-pricing, consumer surplus is denoted by S_k and S_k^o, respectively.

Aggregate welfare is defined as the sum of profits and consumer surplus.

Although we are primarily interested in the incentives for updating, some general results with regard to the decision to produce the database in the first place should briefly be recalled:[19]

- The socially optimal use of a database would require the marginal user to pay a price of zero (or, more generally, a price equal to c) for database services. Since the information contained in the database is characterized by nonrivalry in use, all users with a positive valuation should be admitted. The sum of consumer surplus and producer profits is maximal at the maximum possible x. Any positive price above zero (or c) generates a so-called 'welfare loss due to underutilization' (cf. Novos and Waldman (1984)).

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17 This can be seen from setting marginal revenue equal to zero for both cases. In the case of an up-to-date database, this means that $p(x) + x(dp/dx)$ must equal zero. In the case of an out-of-date database, $\gamma(p(x) + x(dp/dx))$ must equal zero. Solving both both first order conditions must result in an identical x.

18 If copiers enter the market, competition will lead to a price equal to the long run minimum average cost of copiers, k. The profit to the original producer will depend on the amount of database services he supplies under competition. Thus, the producer gets maximum profit if his market share is one hundred percent.The maximum possible profit in the case where copiers enter the market is equal to the profit the producer can get for sure if he sets his price at a level that prevents copiers from entry. If potential copiers are expected to enter the market as long as they can at least cover their long run minimum average cost, then the original producer will be able and will have an incentive to prevent copiers from entering the market by setting his price at $k - \varepsilon$ (with $\varepsilon > 0$). As ε can come arbitrarily close to zero, the price set by the producer can be said to equal k. Note that under this assumption copiers will never supply database services. The threat of competition, however, forces producers to set Betrand-prices. Note also that the producer, being the sole supplier of database services, is efficient as long as $k > c$. If the producer can serve an additional user more cheaply than a copier, copying databases involves a waste of resources.

19 These results draw on the more general welfare analysis of copyright protection (see e.g. Koboldt, 1995).

- A database should be produced if the costs of creation *F* are less or equal to the sum of individual valuations. This resembles the well-known optimality condition for the provision of public goods. Unless producers can engage in perfect price discrimination, the profits from the sale of database services they can earn to cover the costs of creating the database are less than the sum of individual valuations. Therefore, profit maximising producers will not necessarily produce a database if it were socially optimal to do so.[20]
- Whenever producers are restricted in their price setting by the threat of competition by potential copiers, profits from the sale of database services are less than monopoly profits. Therefore, a database that would have been produced by a profit-maximising monopolist in the absence of potential competition will not necessarily be produced if the original producer can expect copiers to compete with him. A legal provision that effectively prohibits copying serves as an incentive for the production of a database. The legal protection of databases, therefore, diminishes the so-called 'social welfare loss due to underproduction' (see also Novos and Waldman(1984)).[21]
- Legal protection of databases changes the incentives to the producers of databases only if *k* is lower than the respective monopoly prices. The threat of copying may be an impediment to the production of databases only if the costs associated with copying itself are sufficiently low. The costs of copying a database may show extreme variations. While it may be very costly to copy a database[22] that is accessible only for on-line research, copying a database that is distributed on CD-ROM could be relatively cheap.[23] Thus, legal protection of databases may be an issue only if distribution on CD-ROM is relatively important as compared to on-line access.

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20 We will abstract from the possibility of side-payments between users and producers. This issue is captured in perfect price discrimination since, to ensure production whenever it is socially optimal, each user would have to pay his individual net benefit from the use of database services at a given price *p* which should be set to zero (or *c*). Therefore, a scheme of side-payments that guarantees production whenever it is socially optimal is equivalent to perfect price discrimination.

21 It should be obvious that even in the case of monopolistic producers, the number of databases produced may be below the socially optimal level. Thus, the possibility of a social welfare loss due to underproduction exists, unless the producer of at least the 'marginal' database can engage in perfect price discrimination. Since a reduction of the welfare loss due to underproduction which raises profits from the sale of database services (without price discrimination) necessarily leads to higher prices and lower quantities, this will increase the social welfare loss due to underutilization.

22 ... or to extract its content in a form that can be used by the extractor to supply database services himself...

23 A database on CD-ROM contains not only the data, but also the retrieval system necessary to access the information.Furthermore, with access to the complete database on CD-ROM, information about how the data are organized can be obtained from a detailed analysis of the database.

In the following analysis, we will focus on the problem of updating, assuming that the database has been produced. A producer will decide to invest in updating as long as the cost of updating is less than the fall in profits he would otherwise incur as a result of the database becoming out of date. The decline in profits that can be prevented by updating depends on whether the producer will be subject to (potential) competition from copiers after updating and, thus, on the legal regime and on the value of k. Table 1 summarises the respective conditions for individually and socially optimal updates in different cases. [24]

Table 1: Conditions for individually and socially optimal update

	$k < \gamma p_m$	$\gamma p_m \leq k < p_m$
limited protection	***Case I.1***	***Case I.2***
	$U \leq (\pi_k - \pi_k^o)$	$U \leq (\pi_k - \gamma\pi_m)$
	$U \leq (\pi_k - \pi_k^o) + (S_k - S_k^o)$	$U \leq (\pi_k - \gamma\pi_m) + (S_k - \gamma S_m)$
extended protection conditional on update	***Case II.1***	***Case II.2***
	$U \leq (\pi_m - \pi_k^o)$	$U \leq (\pi_m - \gamma\pi_m)$
	$U \leq (\pi_m - \pi_k^o) + (S_m - S_k^o)$	$U \leq (\pi_m - \gamma\pi_m) + (S_m - \gamma S_m)$

We will first look at the producer's incentive to update. The maximum level of U for which an update is individually rational is defined by the conditions in Table 1.

Comparing the condition for individually optimal updates, we find that the incentive to update (measured by the maximum or cut-off level of updating cost that the producer is willing to incur) is smallest in the case where the updated database would attract copiers, but an out-of-date database would not (Case I.2)

The incentive to update is largest in the case where by updating the term of protection can be extended and both the updated and the out-of-date database would attract copiers (Case II.1). In this case, by updating, the producer does not only prevent the devaluation of the database, but he also ensures a position in which he can earn monopoly rather than Bertrand profits.

The second largest incentive to update is given where updating does not lead to a change in effective protection compared to not updating, i.e. in the

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[24] One has to be careful with respect to the 'optimality' of producer's decisions. Since a database, once produced, will not be used to a socially optimal extent as long as $k > 0$, no first-best solution can be achieved. Optimality, therefore, refers to the best possible result (in terms of welfare) in each setting.

situation where an additional period of protection will be achieved by updating, but this extension will be relevant only for up-to-date databases because an out-of-date database would not attract copiers (Case II.2). In this case, updating does not have the effect of converting Bertrand profits into monopoly profits.

This relative position of the respective cut-off levels can be derived from the following inequalities:

$$(\pi_k - \gamma\pi_m) < (\pi_k - \pi_k^o) < (\pi_m - \gamma\pi_m) < (\pi_m - \pi_k^o)$$

The first and the last inequality require $\gamma\pi_m > \pi_k^o$, which must be true because $\gamma\pi_m$ is the maximum profit that can be earned from the sale of an out-of-date database which must be greater than π_k^o. The remaining inequality holds if the absolute size of the loss from being forced to set the Bertrand price is greater for an up-to-date database ($\pi_m - \pi_k$) than for an out-of-date database ($\gamma\pi_m - \pi_k^o$). A sufficient condition for this is that the marginal revenue from selling an additional unit of database services from an up-to-date database is greater than the marginal revenue for an out-of-date database. Given our assumption that the valuation of an out-of-date database is a fraction of the valuation of an up-to-date database (expressed by inverse demand functions $p(x)$ and $\gamma p(x)$ respectively), this condition holds.

To sum up, we find an increase in the incentive to update from Case I.2 to Case I.1 to Case II.2 to Case II.1.

Comparing the incentives for updating faced by the producer and the conditions for socially optimal updating, we find that the individual incentives are smaller than is socially optimal except for the situation where updating leads to an extension of protection and both the out-of-date and the up-to-date database would be subject to the threat of potential competition from copiers. In this case, the producer may even want to update the database although the database should not be updated from a social point of view. Thus, the possibility to extend protection by updating creates an *incentive for excessive updating*.

Whenever the difference in consumer surplus brought about by updating is positive, the maximum level of U for which updates are socially optimal exceeds the level for which updates are individually optimal. For the case of limited protection, the difference is $S_k - S_k^o$ (Case I.1) and $S_k - \gamma S_m$ (Case I.2), respectively (see Table 1). Clearly, if the price charged for database services is the same, then consumer surplus is greater for an up-to-date database than for an out-of-date database. Hence the first difference is positive (Case I.1). Furthermore, the consumer surplus is greater at the Bertrand price than at the monopoly price ($S_k > S_m$) so that for $\gamma \leq 1$ the second difference must be positive, too (Case I.2). Therefore, in the case of limited protection there are levels of update costs at which a profit maximising supplier will decide against updating even though updates would be socially preferable.

The same is true for the case of extended protection conditional on updating where an out-of-date database would not attract copiers (Case II.2). The relevant difference in consumer surplus is given by S_m - γS_m, which by definition is positive for $\gamma < 1$.

This leaves us with case II.1, i.e. the case where updating leads to extended protection, and an out-of-date database would attract copiers. In this case, the difference in consumer surplus is given by S_m - S_k^o, and this difference will be negative if $S_m < S_k^o$. We can write consumer surplus in the case of Bertrand pricing of an out-of-date database as

$$S_k^o = \gamma S_m + x_m(\gamma p_m - k) + \int_{x_m}^{x_k^o} [\gamma p(x) - k]dx .$$

Therefore, the difference is given by

$$S_m - S_k^o = (1-\gamma)S_m - x_m(\gamma p_m - k) - \int_{x_m}^{x_k^o} [\gamma p(x) - k]dx .$$

This difference will be less than zero if the last two terms together are greater than (1 - γ)S_m, which is the more likely the closer γ is to 1, and the lower is k. This is to say, that an incentive for excessive updating, expressed by the fact that consumer surplus will decrease as a consequence of updating leading to an extended term of protection, is the more likely to occur the less the database loses in value from getting out of date, and the lower the price at which database services would have to be sold under the threat of competition from copiers.

To verify that society as a whole may be worse off from updating in the case where updating creates a monopoly situation (whereas without updating we would have Bertrand competition), we have to look at the difference in total welfare which is given by

$$(S_m + \pi_m) - (S_k^o + \pi_k^o) - U = (1-\gamma)\int_0^{x_m} p(x)dx - \gamma\int_0^{x_k^o} p(x)dx - U$$

Clearly, for γ getting close to one (i.e. for a small devaluation of an out-of-date database), although it is in the interest of the producer to invest in updating, this leads to a decline in total welfare . For γ getting close to one, updating does not create any value. Granting producers extended protection if they update the database in this case leads to pure rent-shifting from consumers to producers.

4. The EC-directive and the Incentives to Update

We now want to apply the results from the previous section to the legal provision incorporated in the proposed directive for the legal protection of databases:

1) Even though awarding a monopoly position to the producers of databases by granting them legal protection creates an additional incentive for updating databases, they may fail to update the database if it were socially optimal to do so. The reason is that the social value of an update is not adequately reflected in monopoly profits.

2) By awarding a monopoly position to the producers of databases, the social value of updates is diminished. This is due to the fact that although updating avoids a decrease in the social value of the database, this comes at the cost of a social welfare loss due to underutilisation. Thus, from society's point of view it may be better to have out-of-date databases available at a low price rather than having up-to-date databases available at a high price. Updating, although increasing the social value of the database, may very well hurt society if it can be obtained only by awarding monopoly rights to the producer, thereby reducing the number of users that will access the database.

3) If the lifetime of the database is longer than the effective term of protection (i.e. longer than 15 years for protection against unauthorised extraction), the producers may decide not to update the database even if it were socially optimal to do so after the protection has expired.

4) Granting a renewed term of protection conditional on investment which gives rise to 'substantial changes' of the database will increase the incentive to update. This increased incentive, however, may come from rent shifting from users to producers and may thus be harmful to society as a whole. Thus, the provisions that allow for obtaining a fresh term of protection may create an incentive for excessive updating the database.

5) This excessive incentive is the more likely, the lower the decrease in valuation that can be prevented by updating and the lower the price at which database services would be sold under threat of competition from copiers.

6) Thus, the provision of granting a fresh term of protection conditional on substantial changes suffers from serious problems[25]:

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[25] This seems to be of practical relevance mainly with regard to the right to prevent unauthorized extractions. It is more plausible to assume the lifetime of a database to be greater than 15 years than to assume the lifetime of the database to be greater than the term of copyright protection (e.g. 70 years after the death of the author).

- If updating the database does not constitute a substantial change and the lifetime of the database is greater than the term of protection, then the legal protection provided by the proposed directive is insufficient inasmuch as for certain periods the incentive to update the database decreases, despite it being socially optimal to update the database.

- If updating the database constitutes a substantial change, this provision may create an excessive incentive for updating.

7) This indicates that the exact determination of what level of investment in updating should be considered as a "substantial change" plays a crucial role. While it might seem plausible to define substantial changes by specifying a "minimum effort" that has to be undertaken in order to receive renewed protection, our analysis suggests that it is important to set an upper limit to updating cost.

8) If updating prevents the database from losing value, producers should have a natural incentive to invest in updating, in particular if updating costs are low. This incentive can be increased by granting extended protection following an update, i.e. producers will update the database in cases where they would not have done so without extended protection. However, because the social value of updates decreases, updates requiring extended protection may not be socially desirable. The socially problematic cases are those in which the producer has an excessive incentive to invest in updating. The above condition for updates which are not socially harmful can be rewritten as

$$U \leq (1-\gamma)\int_0^{x_m} p(x)dx - \gamma\int_0^{x_k^o} p(x)dx$$

which implicitly defines an *upper limit to updating cost*. Extended protection should be denied if the producer has invested more than this threshold value in updating, because this indicates that this decision has been motivated by socially harmful rent-shifting considerations.

5. Concluding remarks

The previous sections have shown how the impact of the proposed directive on the incentives to update databases may be analysed with standard economic tools. The results of this analysis have been summarised in section 4. Of course, this analysis could be extended and refined. Aside from

extending the model[26], the analysis presented above could be supplemented by considerations from the New Institutional Economics.

This would shift the focus of the analysis from 'gross welfare' comparisons to the way in which suppliers and users of database services interact. Thus, more attention would be paid to the different forms of contracts that govern the relationships between database producers and users.

Supposedly, the contracts differ widely between databases that are accessible via on-line research and those that are distributed independent of networks via CD-ROM. In the past, databases have been produced and distributed even without the explicit legal protection granted by the proposed directive.[27] Obviously, the problem of an adequate remuneration to the authors of databases or the providers of database services has been solved without the help of the law. The arrangements between suppliers and users that have been arrived at by contracting between these two parties, could be used as a benchmark against which to compare the proposed directive.

Another approach could focus on how the introduction of explicit legal protection changes the positions of the contracting parties, the distribution of gains from contracting, and, thus, the incentives that users and suppliers of database services will face. Of course, this kind of analysis requires a more sophisticated modelling than the type of welfare analysis provided in this paper. Nevertheless, even simple welfare analysis should make clear that a piece of legislation such as the proposed directive for the legal protection of databases will change the economic environment of the respective decision makers in many ways. The analysis shows that provisions like the renewal of the term of protection conditional on making substantial changes which, at first glance, looks like a clever solution, may, on closer inspectionm, reveal some shortcomings.

In any case, the question of how new forms of information goods should be protected by law—if they should be protected at all[28] - and how legal protection creates and changes incentives to producers and users, can be seen as a promising ground for future research in law and economics.

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26 The model could be extended, for example, by discounting future profits, costs and surplus or allowing for a gradually decreasing valuation of out-of-date databases or a gradually increasing cost of updating with the number of periods the database has not been updated.

27 All over the world, approximately 3000 databases are provided for on-line research.The number of databases available on CD-ROM is assumed to increase sharply in the future (cf. Mehrings, 1989 or Hoebbel, 1993).

28 For a general treatment of legal protection for new forms of information goods see Reichman (1994).

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