International Law and Economics

Marc Scheufen

Copyright Versus Open Access

On the Organisation and International Political Economy of Access to Scientific Knowledge

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On the Organisation and International Political Economy of Access to Scientific Knowledge

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Marc Scheufen
Ruhr University of Bochum
Faculty of Law
Bochum
Germany

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The academic custom to write research articles for impact rather than money may be a lucky accident that could have been otherwise. Or it may be a wise adaptation that would eventually evolve in any culture with a serious research subculture

– Peter Suber (2012, p. 11)

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Selfkant, Germany Marc Scheufen
September 2013

Contents

Abbreviations

A2K	Access to Knowledge
AEA	American Economic Association
AER	American Economic Review
AGORA	Access to Global Online Research in Agriculture
APC	Article Processing Charge
ARDI	Access to Research for Development and Innovation
ARPANET	Advanced Research Projects Agency Network
ASGAP	American Society of Composers, Authors and Publishers
ATA	Alliance for Taxpayer Access
BMI	Broadcast Music Incorporated
BOAI	Budapest Open Access Initiative
CA	Closed Access
CC	Creative Commons
CCAL	Creative Commons Attribution License
CCBY	Creative Commons Attribution License (formal code)
CCBYNC	Creative Commons Attribution-Noncommercial
CCBYNCND	Creative Commons Attribution-Noncommercial-No-Derivatives
CCBYNCSA	Creative Commons Attribution-Noncommercial-Share Alike
CCBYND	Creative Commons Attribution-No Derivative Works
CCBYSA	Creative Commons Attribution-Share Alike
CCS	Copyright Collective Societies
CD	Compact Disc
CDM	Clean Development Mechanism
COAR	Confederation of Open Access Repositories
CTEA	Copyright Term Extension Act
CV	Curriculum Vitae
DC	Developing Country
DFG	Deutsche Forschungsgemeinschaft
DiD	Difference in Difference
DMCA	Digital Millennium Copyright Act
DOAJ	Directory of Open Access Journals

DRIVER	Digital Repository Infrastructure Vision for European Research
DRM	Digital Rights Management
DVD	Digital Virtual Disc
EC	European Commission
ERIC	Educational Resources Information Center
EU	European Union
FAO	Food and Agriculture Organization
GBS	Google Book Search
GDP	Gross Domestic Product
GEMA	Gesellschaft für musikalische Ausführungs- und mechanische Vervielfältigungsrechte
GNI	Gross National Income
GNP	Gross National Product
HINARI	Health InterNetwork Access to Research Initiative
HOA	Hybrid Open Access
IC	Industrialized Country
ICT	Information Communication Technology
IP	Intellectual Property
IPR	Intellectual Property Rights
ISI	Institute for Scientific Information
ISSN	International Standard Serial Number
IT	Information Technology
ITOC	Information Training and Outreach Centre
JCR	Journal Citation Report
JISC	Joint Information Systems Committee
KCC	Knowledge Commons Committee
L&E	Law and Economics
LAC	Latin America and the Caribbean
LIBER	Ligue des Bibliothéques Européennes de Recherche
MB	Marginal Benefits
MC	Marginal Costs
MPDL	Max Planck Digital Library
MPG	Max Planck Gesellschaft
NECOBELAC	Network of Collaboration Between Europe & Latin American Caribbean Countries
NIH	National Institute of Health
OA	Open Access
OARE	Online Access to Research in the Environment
OAWG	Open Access Working Group
OECD	Organization for Economic Co-operation and Development
OSI	Open Society Institute
OSS	Open Source Software
PK	Public Knowledge
PLoS	Public Library of Science
PNAS	The Proceedings of the National Academy of Science

PSI	Public Sector Information
RCUK	Research Councils United Kingdom
RePEc	Research Papers in Economics
RERCI	Review of Economic Research on Copyright Issues
ROAR	Registry of Open Access Repositories
ROARMAP	Registry of Open Access Repositories Mandatory Archiving Policies
RRS	Reproducible Research Standard
SCST	Select Committee on Science and Technology
SEK	Swedish Krona
SERCI	Society of Economic Research on Copyright Issues
SPARC	Scholarly Publishing and Academic Resource Coalition
SSCI	Social Science Citation Index
SSCR	Standing Committee on Copyright and Related Rights
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UK	United Kingdom
UKPMC	United Kingdom PubMed Central
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDROIT	International Institute for the Unification of Private Law
UrhG	Urheberrecht (German Copyright Law)
US	United States
USA	United States of America
USD	United States Dollars
U.S.C.	United States Copyright
VG Wort	Verwertungsgesellschaft Wort
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

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Chapter 1
Introduction

It was Sir Isaac Newton to acknowledge that if he had seen further, it was by standing on the shoulders of giants (Turnbull 1959). Obviously, the production process in scientific research may be best characterized as being cumulative. Consequently, each scientific work can be seen as a "module" on which others can build, extend or debug.[1] This brings the issue of appropriate access to scientific knowledge on the agenda. Access to the literature is provided by means of disseminating academic works via journal publications. The predominant journal publishing model, meanwhile, reverts to copyright privileges as a lever for the emergence of (commercial) publishers and printers. However, a recent debate in the (economic) literature reveals a growing dissatisfaction with this traditional publishing model.

There are eventually two reasons why the role of copyright for academic works is currently intensively being debated: First and foremost, the prices for academic journals have increased dramatically in the last two decades. Ramello (2010) finds that between 1986 and 2004 serial expenditures and serial unit costs have increased by 273 % and 188 %, respectively. At the same time, the consumer price index increased by only 73 %. In some disciplines—e.g. physics and chemistry journals—subscription prices even rose by more than 600 % (Edlin and Rubinfeld 2004). The vast increase of subscription prices was primarily driven by new options for publishers to excessively engage in price discrimination. In this respect, the copyright system provides the necessary prerequisite for such pricing strategies as it grants an exclusive right to control access to journal content. Moreover, the digital revolution ushered in by the internet eventually increased the options for price discrimination as it provided with the technological means for customization,

[1]The term "module" refers to the literature describing the open source software development process. Accordingly, a module describes a new piece of code (knowledge) in the production of a software (theory). We will see later that programmers and scientists have eventually many things in common (Scheufen 2011). See also Willinsky (2005).

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versioning and bundling of information goods.[2] The increase of journal subscription prices, finally, has significantly affected university libraries in their ability to subscribe to journals.[3] Budget cuts at academic institutions in several countries have even worsened the situation and plunged (university) libraries into a serious crisis (serials crisis). Second and more interestingly, the copyright system that allows for such price settings seems rather negligible in the context of scientific research. While copyright seeks to stimulate the creation of works in art, literature and science by granting exclusivity as a means to appropriate a sufficient portion of the consumer rent, scientists are rather motivated by reputation gains from publishing.[4] In fact, researchers are not primarily interested in financial gains from selling their research results—which are most often negligible anyway[5]—but in indirect rewards which accrue by means of reputation or CV-effects (Watt 2010, p. 1). The latter aspect is particularly relevant for the big body of peer-reviewed scholarly articles and their preprints. Peter Suber refers to these works as royalty-free literature, which has two important implications: First, the publisher receives the work from the authors at no costs. Second, the author should (ceteris paribus) be open to the publishing mode (open or closed access) as she is not losing any revenue (Suber 2012, p. 9). It is this type of literature that we will have in mind when analyzing the impact of copyright versus open access for the scholarly system as a whole.

With the advent of the internet and the birth of alternative business models for publishing academic works—especially the Open Access (OA) model—the aforementioned observations gained particular interest in the public debate. In particular, open access seeks to provide unrestricted (free) access to scientific literature via "the public internet, permitting any user to read, download, copy, distribute, print, search, or link to the full text of these articles [...] without financial, legal or technical barriers [...]." (BOAI 2002). Especially academic associations' but also individual researchers' initiatives have since advocated the new OA movement as a counterbalance to the traditional copyright model. Since the beginning of the new millennium several international and national initiatives—

[2] See Lunney (2008) on the impact of digital technologies for the ability to price discriminate in the market for information goods. In this context, Yuan (2010) highlights that digital technologies have eased the process of collecting customer information (Ulph and Vulkan 2000) and reduced the costs of customization, versioning and bundling strategies (Shapiro and Varian 1998; Bakos and Brynjofsson 1999, 2000; Viswanathan and Anandalingam 2005).

[3] Noll (1996) shows that high institutional subscription prices causes libraries to be far smaller than would be socially optimal.

[4] Obviously, the copyright privilege seems rather important for the incentives of the publisher. In our analysis we will primarily focus on the researcher's incentives. Nevertheless, as we believe that publishers meet an important function in academia, there needs to be some form of publishers remuneration. We will further elaborate on the role and incentives of publishers in Chap. 5.

[5] Note that this is a general feature of the cultural industry. As a matter of fact, empirical findings show that royalties are often negligible, and there is no evidence that copyright increases the creators' earnings (Tenopir and King 2000; Towse 2001).

like the "Budapest Open Access Initiative" (2002),[6] the Bethesda Statement on Open Access Publishing" (2003)[7] and the "Berlin Declaration on Open Access to Knowledge in Science and Humanities" (2003)[8]—have tempted to foster open access to scientific knowledge. The vast increase in the number of OA journals[9] (gold road) and the spread of open archives and repositories like SSRN (green road) clearly show the relevance that the OA movement has gained in academic publishing throughout the last decade. As most striking in the OA debate, scholars have been stressing the somehow preposterous nature in science. Accordingly, universities are paying twice: Once in salaries for the production of knowledge and again for the high subscription prices for journals to enable researchers to read their works. Journal publishers as such are acting as intermediaries as they provide with the selection process to prevent from adverse selection (Akerlof's lemons).[10] Thus, the acceptance for journal publication can be seen as a form of branding to signal the quality of a certain paper, where the reputation or ranking of a journal provides with an objective tool for valuation. However, the refereeing and review process as well as editing and formatting tasks is primarily provided by volunteers of the scientific community. So, it is actually the researchers themselves that provide journals with esteem as e.g. the names of well-known professionals appear in the editorial board. In this context, Bergstrom (2001) argues that a fully subsidized edit and review process for content to be published in expensive commercial journals hardly satisfy the criterion of economic efficiency. The added value of paying publishers by means of a transfer of copyright may hence be questioned. In the end, it may be asked as to whether the traditional copyright model or the open access model is better suited to the norms, incentives and organizational structure in the market for science (Eger and Scheufen 2012b, p. 53).

As a means of (economic) analysis, the topic has only recently aroused interest among scholars in the field of "law and economics".[11] Most attention was directed to a paper by Shavell (2010) who raised the question of actually eliminating copyright for academic works. Shavell's model concludes as follows: (1) researchers are motivated by reputation, which increases in readership, (2) readership will likely be higher under open access and hence scholarly esteem, (3) the publishing costs from an "author pays" principle under open access will be covered by most universities, and (4) there are several reasons why a shift towards open access publishing will

[6] See http://www.soros.org/openaccess/read (last accessed on September 1, 2014).

[7] See http://www.earlham.edu/~peters/fos/bethesda.htm (last accessed on September 1, 2014).

[8] See http://www.zim.mpg.de/openaccess~berlin/berlin_declaration.pdf (last accessed on September 1, 2014).

[9] In present the "Directory of Open Access Journals" (DOAJ) lists more than 9,900 journals (September 2014). See http://www.doaj.org (last accessed on September 1, 2014). The number of OA journals varies considerably by country and discipline. We will further elaborate on the history and evolution of the OA movement in Sect. 3.2.

[10] See Akerlof (1970).

[11] Primer contributions are works by Litman (2006), Hilty (2007), and Gienas (2008).

not be smooth without legal action (Eger and Scheufen 2012b, p. 55). Ever since, several papers have forwarded a lively debate in academia by reconsidering some of the modelling assumptions from which Shavell (2010) crucially derives his conclusions, showing a much more differentiated picture on the impact of a regime change. Accordingly, several questions—especially with respect to the international dimension of this intriguing question, e.g. the role of OA in developing countries—are still unresolved.

This work addresses some of these questions by providing with a comprehensive analysis on certain issues regarding the superiority of a copyright versus an open access regime in academic publishing. In particular, we will focus on the international dimension of this intriguing question. Standing on the shoulders of Shavell and others, the consequences of a regime change will be analyzed. A closer look at the international political economy of scientific research will particularly address issues in developing countries, seeking a bridge in the "digital divide" argumentation to involve all nations in science. Finally, a comprehensive analysis of copyright legislation and its alternatives in the light of international IP agreements offers prospects on the future of scientific publishing.

The remainder of the thesis is organized as follows: Chap. 2 will introduce to some fundamental economics, sketching the line of reasoning in the economics of copyright and the economics of science and revealing implications by comparing both systems. Chapter 3 shall provide an understanding of the characteristics and the market structure in the market for science and academic publishing as well as to the history and evolution of the OA movement. A comprehensive analysis of both regimes is Chap. 4. In this context, we will first focus on the effectiveness of either regime in stimulating research and producing social welfare in a purely global science community. In the following, policy implications and reforms of IP legislation at the international level are being discussed, especially accounting for the perspective of developing countries. Chapter 5 summarizes possible scenarios for the future of academic publishing. We will conclude in Chap. 6, stressing an agenda of seven recommendations to be considered for the future of academic publishing.

Chapter 2
Some Fundamental Economics

2.1 The Economics of Copyright

2.1.1 The Basic Concept of Copyright

Understanding the Principles of Copyright

Copyright—lat. *copia*, plenty or to make plenty—generally provides its rightholder with "an exclusive right to copy, reproduce, distribute, adapt, perform or display" (Scotchmer and Maurer 2006, p. 76) her works of creative expression.[1] That is, the rightholder receives a bundle of exclusive rights which allow to exercise control over the use of her works for a specific period of time. In most states of the world and for the majority of existing works this period is set at author's life plus 70 years.[2] An exception to this rule concerns works for hire,[3] where the copyright term is limited

[1]Note that for matters of simplicity we refrain from comparing all the differences between national copyright laws in detail. Instead, we will primarily refer to two models with the US Copyright and the German Urheberrecht, representing two different approaches (US versus Continental Europe)—especially regarding the scope of protection. References to other national features will only be made where appropriate. Accordingly, the features of the German Urheberrecht shall also represent similar characteristics as codified under other national legislation in continental Europe.

[2]Note that the terms of copyright have been subject to change by legislation, especially within the last two decades. See the next section on the history of copyright for a more detailed picture.

[3]Following section 101 of the US Copyright Act (U.S.C) a "work made for hire is (1) a work prepared by an employee within the scope of his or her employment; or (2) a work specially ordered or commissioned for use as a contribution to a collective work [...]" (*17 U.S.C. §101*). This distinction, however, is not applied in all copyright systems of the world. The German "Urheberrecht", for instance, does not include such a distinction as the copyright is always assigned to the creator of a work. The creator can only grant certain rights of use to a third party (Eger and Scheufen 2012b, p. 39).

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to either 95 years after publication or 120 years after creation. After expiration the work enters the public domain.[4]

Copyrightable subject matters are creative[5] works of authorship in art, literature and science, fixed in any tangible medium of expression.[6] In particular, copyright protection refers to any creative activity expressed in artforms, including for example literary works and programs for data processing (particularly computer software), musical works (including any accompanying words), pantomimes and choreographical works, dramatic works (including any accompanying music), graphic arts and architecture, pictorial and sculptural works, motion pictures and other audiovisual works as well as illustrations of scientific and technical form (Raskind 1998; Rehbinder 2006).[7] The fact that copyright protection has been extended to cover not solely aesthetic subject matters, but also works of fact (like maps and directories) as well as data bases and computer programs shows that the sometimes mistakenly assumed difference between "copyright solely for creative works" and "patents for industrial products" has become somewhat blurred. As a matter of fact, for some products a creator may even choose between the two, as it is the case for computer programs.[8] Also the combination of both rights is common in practice. Besides, some functional articles may be sought either under copyright or under the design patent regime, whereas in this context an attachment of a copyright to a product that already receives protection under the design patent is ineligible (Besen and Raskind 1991, p. 13).

For understanding the basic principles underlying the system of copyright law, however, it is important to emphasize its distinct features as compared to patent law and other forms of industrial property rights (like trademarks or industrial design).

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[4]In contrast, the patent law provides with 20 years of exclusive use for a technical invention. However, it is worth to note that not all forms of intellectual property rights expire after a certain period of time. For example, trademark protection can last virtually forever.

[5]As such, at least a minimum degree of creativity is required for copyright protection. However, the term "creativity" is somewhat blurred as it is not explicitly defined by the law. Especially in the economic literature on copyright creativity is often neglected. For a discussion see Demsetz (2009) and Towse (2006).

[6]For an overview on the general subject matters of copyright see 17 U.S.C. §102 for creative works produced in the USA. In the German "Urheberrecht" the subject matters are listed under §1 and §2 UrhG.

[7]Here, Raskind (1998) emphasizes that even though copyright originates in the technology of printing, reforms in copyright law have been extending the subject matters of copyright protection as a response to advancements in the technologies to copy, reproduce and distribute copyrighted works. See Eger and Scheufen (2012a) on the changes and challenges of copyright law in the light of technological change.

[8]Note that there are differences between national copyright and patent laws regarding particular subject matters. As such, software may be a subject matter under US Patent Law (but also under US Copyright Law), while software is solely a subject matter under copyright in European membersstate's IP laws. Only if a software-related invention exhibits a certain technical character, as is the case for the ABS brake system. On the "patent and/or copyright for software" debate see Watt (2007).

First and foremost, copyright law grants an exclusive right independently of any application or registration process. Notwithstanding the possibility of registering and depositing a work at the Copyright Office, the copyright generally arises "self-contained" by means of the creation of the work. In particular, protection to an original[9] work of authorship[10] is granted subject to its fixation in any tangible medium of expression. Following section 101 of the US Copyright Act this "fixation" requirement involves that a work is embodied in a copy or phonorecord, by or under the authority of the author, and "is sufficiently permanent or stable to permit it to be perceived, reproduced, or otherwise communicated for a period of more than transitory duration" (17 U.S.C. §101).[11] Thus, this requirement is already met when "the word processor causes the word order to be printed on paper" in the context of a literary work or when a song is being performed on a recording medium like a CD or MP3.[12] As a consequence, the definition of claims in copyright law and hence its scope is subject to litigation. While in patent and trademark law a comprehensive review of the file by the Patent and Trademark Office provides for the validity of a patent or trademark, respectively, the copyright leaves the claim for validity to the copyright holder, i.e. the author must provide evidence to verify validity of her copyright (Besen and Raskind 1991, pp. 11 et seq.). Second, section 102(b) of the US Copyright Law specifies that "in no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work." (17 U.S.C. §102(b)). Thus, copyright only protects the expression within a work, but not the idea expressed by the author. In this respect, copyright protection is much narrower than a patent, since a patent grants a monopolistic right regarding a (complete) technology and hence the idea of an innovation. Third and somehow related is the feature of "independent creation". Copyright law primarily focuses on actual copying, considering any use as an infringement of an author's exclusive right if a person actually copies a protected work. That is, any independent creation of a similar or even identical work (duplicate) does not

[9]Originality implies that it owns its origin to the author and does not simply constitute a copy of some earlier work. However, the originality requirement is not as restrictive as the novelty requirement in patent law. A (derivative) work that incorporates other works can still be original and hence subject to copyright protection.

[10]Authorship refers to the requirement that a work needs to represent a modicum of intellectual activity. Besen and Raskind (1991) provide a simple example for understanding the basic idea. As such, if "a chimpanzee were to manipulate the keyboard of a personal computer with a graphics program" (Besen and Raskind 1991, p. 12), then protection would not be granted as the required modicum of intellectual activity is deemed lacking.

[11]For reference to the US Copyright Law see henceforth http://www.copyright.gov/title17/circ92.pdf (last accessed on September 1, 2014).

[12]In this context, it is important to note the difference between the information good (e.g. the content of a book, the melody of a song etc.) and the information medium or carrier (e.g. the paper in the context of a book, the CD or MP3 medium for music etc.).

violate any of the right holder's exclusive rights and receives protection in equal measure (Gordon and Bone 1999, p. 190). As a consequence, there is no such principle as priority—which plays a major role in patent law (first-to-file versus first-to-invent).[13] Finally, copyright law defines not only its subject matter and the granted rights, but also its limitations more specifically as compared to the patent statute (Besen and Raskind 1991, p. 12). As such, section 102 of the US Copyright Act explicitly lists the categories that are considered as a work of authorship. Once a work is subject to protection, copyright accords six basic rights to its owner: (1) the right to reproduce the copyrighted work in copies or phonorecords, (2) the right to prepare derivative works upon the copyrighted work, (3) the right to distribute the work in copies or phonorecords (including sale, rental, lending, leasing or other forms of ownership transfer), (4) the right to perform the protected work (in the case of literary, musical, dramatic and choreographic works, pantomimes, and motion pictures and other audiovisual works), (5) the right to display the protected work publicly (in the case of literary, musical, dramatic and choreographic works, pantomimes, and pictorial, graphic, or sculptural works) and (6) in the case of sound recordings the right to perform the copyrighted work publicly by means of a digital audio transmission (17 U.S.C. §106). However, as copyright law seeks to balance the rights of the owner of a protected work with the public interest of having access,[14] the law provides with a number of limitations and exceptions that allow the use (with or without payment of compensation) of a copyrighted work without first seeking permission (authorization) from its rightholder(s).[15] As copyright law is (still) a national law, however, these limitations and exceptions to copyright (and related rights) vary considerably between nation states. This diversity is acknowledged partially by international treaties which provide with general conditions for the application of such restrictions to the copyright. In this respect, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) constrains national exceptions to the Berne Three-Step Test. Despite the efforts in harmonizing national IP laws (in the sense of providing minimum standards), article 10 of the World Intellectual Property Organization (WIPO) Copyright Treaty[16] emphasizes still the will to leave it to the national legislation to decide on whether or not a certain limitation or exception is to be applied and if so, to determine its scope. Despite all these differences in the embodiment of limitations and exceptions in national copyright laws, copyright is mainly limited by the concepts of "fair

[13]For a discussion of "first-to-file versus first-to-invent" see Frost (1967).

[14]On the economics of this basic goal of copyright law see Sect. 2.1.2.

[15]Note that the "originality" requirement—with the integrated principle of independent creation, meaning copyright protection in equal measure for identical works that have been created independently—and the fact that copyright provides protection for the expression only (not the idea) may also be considered as limitations to copyright. The same also applies to the duration of copyright which limits copyright protection to a particular period of time.

[16]See http://www.wipo.int/export/sites/www/treaties/en/ip/wct/pdf/trtdocs_wo033.pdf (last accessed on September 1, 2014).

use" and independent creation (Watt 2004, p. 157). As previously mentioned, the latter concept of independent creation allows for equal protection of two identical works (duplicates) that have been created independently. Consequently, copyright protection is limited in so far, as it considers a use to be an infringement if a work has actually been copied. The "fair use" argument limits the scope of copyright protection as certain uses are considered to be "fair" in the sense that the benefits of such uses to the public are assumed to outweigh the negative effects on the rightholders. However, the conceptualization of this copyright limitation differs considerably between national copyright law systems. In general, two distinct traditions on "fair use" limitations have evolved in copyright history[17]: on the one hand, the "fair use" doctrine in US Copyright Law (17 U.S.C. §107) and "fair dealing" in UK Copyright Law (sections 29 and 30 of the UK Copyright, Designs and Patents Act)[18] respectively, and on the other hand, the "catalogue of exceptions" (Schrankenkatalog) in European Copyright Laws (in Germany, e.g. §§44 et seq. UrhG)[19]. The "fair use" doctrine (and the concept of fair dealing in UK Copyright Law) generally provides with a flexible instrument for assessing whether a use should be considered as "fair" and hence non infringing by means of a four-factor balancing test, explicitly taking into account the benefits and costs of certain uses of copyrighted works. In particular, section 107 of the US Copyright Law lists four statutory factors: First, the purpose and character of the use, raising two important issues to be evaluated: the commercial and the transformative character of the use. Second, the nature of the copyrighted work, explicitly taking into account the degree of creativity as "more creative" works are considered to be "closer to the core of intended copyright protection." (Campbell 1994, p. 586). Third, the amount and substantiality of the portion used, reflecting on the degree to which a work has been copied and the relevance of the copied fraction in relation to the complete work. Obviously, the higher the amount of copied material, the less likely may be to justify such a use by a "fair use" argumentation. Fourth, the effect of the use upon the potential market for or the value of the copyrighted work, evaluating the costs imposed on the rightholder due to e.g. competition with a new product. In judging whether a use is conceived as "fair" in reference to section 107 of the US Copyright Law, finally, all four statutory factors have to be weighed against each other.[20] However, the list of section 107 is not exhaustive. In particular, the court shall

[17]These differences originate in the distinctive features of two opposite systems: common law and civil law.

[18]See http://www.legislation.gov.uk/uksi/2010/2694/made (last accessed on September 1, 2014).

[19]See http://www.gesetze-im-internet.de/bundesrecht/urhg/gesamt.pdf (last accessed on September 1, 2014).

[20]Note that in *Harper & Row. v. Nation Enterprises* the US Supreme Court stressed the fourth factor as to be most important for assessing a fair use judgement (*Harper & Row v. Nation Enterprises* 1985, 471 U.S. 539). Notwithstanding, in *Campbell v. Acuff-Rose Music, Inc.* the Supreme Court more recently argued that "the four statutory factors are to be explored, and the results weighed together", highlighting the need to weigh all statutory factors against each other (*Campbell, aka Skyywalker et al. v. Acuff-Rose Music, Inc.*, 510).

account for the user's intention in the particular case.[21] In contrast, the European model of copyright law explicitly names all cases that are considered as limitations by means of a "catalogue of exceptions". Apparently, the "fair use" doctrine exhibits much more flexibility as it enables to account for specific circumstances by means of a case law approach. Notwithstanding, US and European copyright laws have certain common limitations that are generally accepted as exceptions in copyright protection. Sections 107 to 122 in US Copyright Law and e.g. paragraphs 44–63 in German Copyright Law (Urheberrechtsgesetz, UrhG) list several uses that are not conceived as an infringement of copyright. These limitations and exceptions—where a copyrighted work may generally be used without seeking authorization of the rightholder (with or without payment of compensation)—include especially uses for academic purposes—like research and teaching. In scientific research, for example, the right to cite and adopt expressions from other authors constitutes a crucial barrier of copyright protection, explicitly taking into account the cumulative character of scientific research and facilitating the creation of derivative works. Besides, exceptions regarding the personal use of copyright material (so-called private copy, e.g. in Germany §53 UrhG)[22] abound as a common category in limiting copyright.[23] As such, copyright law allows for the making of single copies for private use if the source is unapparent illegal and follows a non-commercial purpose (Landes and Posner 1989, pp. 347 et seq.; Eger and Scheufen 2012a, pp. 157 et seq.). Other limitations refer for example to home recording of musical compositions.

Last but not least, a copyright may also be transferred to third parties. Section 201(d) of the US Copyright Law (Chap. 2) specifies that "the ownership of a copyright may be transferred in whole or in part by any means of conveyance or by operation of law, and may be bequeathed by will or pass as personal property by the applicable laws of intestate succession." (17 U.S.C. §201(d)). In particular, two different forms of transfer of copyright exist: (1) Copyright Assignment and (2) Copyright Licensing. The assignment of a copyright involves the transfer of rights in an exclusive and definite manner.[24] The licensing option, in contrast, provides the licensee only with the permission to use a certain right as contractually agreed upon. However, there are considerable differences between national copyright systems regarding the options for the transfer of copyright. The German "Urheberrecht" does not allow the assignment of a copyright, but the option to grant or licence

[21] See Mueller-Langer and Scheufen (2011b) for a recent "fair use" analysis regarding the Google Book Search Project.

[22] Note that the US Copyright Law does not have a general "private copy" exception.

[23] Other categories consider cases like parody, criticism, reviews, news reporting, archiving etc. The "fair use" doctrine (US Copyright Law) and the "catalogue of exceptions" (European Copyright Laws) follow various public goals such as freedom of speech, educational and equality of access as well as issues referring to market failures. See e.g. Hugenholtz (2001).

[24] Notwithstanding, section 203 of the US Copyright Law specifies that a copyright owner has a non-revocable right for the termination of transfers. Consequently, the author of a book may reclaim her copyright. See section 203 U.S.C. on the conditions for the termination of copyright transfer.

certain rights of use, i.e. to grant a license for the right to distribute, reproduce, perform, or display the copyrighted work and obtain royalties for granting the right (Besen and Raskind 1991, p. 14).[25] A licence as such can be exclusive or non-exclusive. With the exclusive licence the licensor grants a certain right to use her work exclusively, i.e. without the option for the licensor to grant such rights to third parties. A common practice in this respect is the transfer of the right to distribute the copyrighted work to the publisher in exchange for participation in sales. The latter type—the non-exclusive licence—involves the option to grant multiple licences for the right to use the copyrighted work. The reasonability of such licences arises out of situations where the ratio of the value of a given piece of copyrighted material and the transaction costs of licensing is relatively small (Besen and Raskind 1991, p. 15). That is, in all cases where individual licensing agreements or vis-á-vis negotiations would involve prohibitively high transaction costs, so-called copyright collectives[26] enter as mediating parties between copyright owner and the consumers of a work. The Copyright Collective collects royalties by compulsory or individual licenses negotiated on behalf of the copyright holders, who in return are remunerated for the use of their works. Especially the compulsory license with statutorily determined license fees allows the remuneration of copyright holders whose works are used within the boundaries considered as limitations of copyright. In this regard, the private copying of copyrighted material is burdened with a fee on blank copying machinery or media (Besen and Raskind 1991, pp. 14 et seq.). However, while the idea of collective administration of copyright is widely shared, the statutory role of the Copyright Collective differs considerably between national legislations. As a consequence, the Anglo-American Copyright system is not as restrictive as the European system, where collective administration is mandatory.

Obviously, the system of copyright law is complex and needs to be seen in historical reflexion to understand the evolution of particular principles and the differences between national copyright legislations. As such, the following section reflects on the history of copyright and successively develops the pillars of the copyright system from its origins to modern copyright law.

The History of Copyright

The history of copyright, meanwhile, is inseparably linked to the development of technologies to produce, copy and distribute copyrightable works (Eger and Scheufen 2012a, pp. 160 et seq.). In particular, the invention of the "moveable type

[25] See §29 UrhG. Accordingly, the rights of use can be granted im- or explicitly.

[26] On the economics of Copyright Collective Societies (CCS) see e.g.Handke and Towse (2007). Well known Copyright Collectives are e.g. the American Society of Composers, Authors and Publishers (ASGAP) and the Broadcast Music Incorporated (BMI) in the USA. In Germany, the "Gesellschaft für musikalische Aufführungs- und mechanische Vervielfältigungsrechte" (GEMA) and the "Verwertungsgesellschaft Wort" (VG Wort) accordingly abound as examples of CCS.

printing press" by Johannes Gutenberg[27] around 1440—along with the invention of ink and paper sometime before—marks the starting point of actually discussing a need to regulate the production and copying of books.[28] Gutenberg's printing press allowed for the first time the efficient mass production of books and eased the possibility to effectively reproduce books in multiple copies (Samuels 2000, p. 11). Prior to that time, the reproduction of books was extremely laborious and time consuming, since every single duplicate of a given work involved the production of handwritten copies by slaves and scribes (in ancient Greek and Roman civilisations), and monks and paid scribes (in medieval times). As a consequence of the introduction of the movable type to the Western World[29] by Gutenberg, however, the costs for producing copies of books were suddenly brought down to only a fraction of earlier copying practices. While the practice of handwritten copying involved high variable costs of production but rather negligible fixed costs, the new printing technology changed the environment to its opposite and hence allowed for the realization of cost advantages by means of unit cost degression.[30] Kapp and Goldfriedrich (1908) estimate that for a book edition of 500 copies the printing press enabled to reduce printing costs by a factor of 5 by the mid fifteenth century and even by a factor of eight at the end of the fifteenth century (as cited in Tietzel 1995, p. 42).[31] As a result, the production of books exploded after this technological revolution with a massive shift in the number of books in libraries all over Europe.[32] Thus, with the dispersion of the printing press in the fifteenth century an occasion was created asking for a regulation of the market for books in order to prevent from the free riding risk[33] for book publishers and authors.

The British Parliament was finally first to recognize a statutory right to copy by enacting the Statute of Anne[34] in March 1710 (Feather 1980, p. 19; Raskind

[27]Originally Johannes Gensfleisch von Sorgenloch, referred to as Johannes Gutenberg. See also Venske (2000).

[28]See chapter one in Samuels (2000) for a comprehensive review on "The Printing Press—The First Copyright Technology".

[29]In fact, in China the printing with carved wooden blocks as well as ink and paper had been invented around the sixth century.

[30]See Eger and Scheufen (2012a) for a discussion.

[31]See also Eger and Scheufen (2012a) on the economic consequences of the printing press invention for the cost structure in the market for books.

[32]Carl Sagan (1980) gives an impression on the effect of the "Gutenberg revolution" by highlighting that the number of books available in Europe increased rapidly from a few tens of thousands around 1450 to more than ten million in 1500. See also Samuels (2000) on page 13.

[33]We will later reflect in detail on the economic reasoning and consequences of a free riding argumentation.

[34]The full title is "An Act for the Encouragement of Learning, by Vesting the Copies of Printed Books in the Authors or Purchasers of such Copies, during the Times therein mentioned". See http://www.copyrighthistory.org/cgi-bin/kleioc/0010/exec/ausgabe/ (last accessed on September 1, 2014).

1998, p. 478; Samuels 2000, p. 12).[35] Notwithstanding, there had been efforts by the British Parliament to effectively regulate the printing prior to the Statute of Anne by granting a state-sanctioned monopoly over the printing of books.[36] After William Caxton had introduced Gutenberg's printing press to England in the fifteenth century, the economic threat of piracy led to the formation of a collective organization (the Stationers' Company) by the printers (known as stationers) in England. In 1557, finally, the Stationers' Company was chartered by royal decree and given the power to effectively control the printing and distribution of writings (Geller 2000, p. 216; Samuels 2000, pp. 11 et seq.). Only the members of the Stationers' Company were allowed to print and distribute books in England. Special licensing acts allowed publishers to receive rights to particular registered works, where only lawfully printed books entered a particular register which was again controlled by the Company (Geller 2000, p. 216). The printing of unauthorized books that were not registered was prohibited and sanctioned with imprisonment. Since members of the Stationers' Company were entitled to enter books into the Company's Register, the Company could virtually stop others from publishing copies (Geller 2000, p. 217). Thus, the charter of the Stationer's Company ultimately granted a monopoly right regarding the printing of books. However, when the last of these licensing acts expired in 1694 the British Parliament was reluctant—despite all lobbying by the Company—to renew the acts. Instead, the parliament enacted the Statute of Anne in 1710 that "for the first time protected the rights of authors rather than publishers of books" (Samuels 2000, p. 12). The rights created under the Statute of Anne provided authors with quite extensive protection of their works for a period of 14 years with an optional renewal for another 14 years and hence a maximum protection of 28 years. Nevertheless, the rights were also restrained under the statute by further specified limitations by which the statute followed other objectives like continued creation of useful literature or the advancement and spread of education. Consequently, granting a property right to the author was seen to follow a greater concern in the sense that the incentive provided to the author was also to serve the interest of society (Samuels 2000, p. 12; Raskind 1998, p. 478). Finally, the

[35] Some authors date the Statute of Anne back to 1709. See for example Varian (2005). The confusion, however, roots in a change from the Julian to the Gregorian Calender. The "British Calender Act of 1750. Implemented Across The Years 1751, 1752, and 1753" (www.exit109.com/~ghealton/y2k/br1752a.html) induced a change in date marking the first day of a year. While before 1751 (Julian calender) the turn of the year was fixed to March 25, the act changed this date to the first of January. So the date of the passing of the Statute of Anne on 25 March 1709 became finally 25 March 1710. See also Samuels (2000) on page 13.

[36] Also in other European countries similar developments came to recognize the need to regulate the market of books. As such, the French crown, for example, entitled publishers with temporary privileges to print and sell designated books (Geller 2000, pp. 217 et seq.). In this regard, especially Italy should be stressed as being among the pioneers in these developments. Here, the city of Venice was first to provide printers and publishers with such privileges in 1469, which made Venice to be the first European publishing centre with more than eight million books being printed in the second half of the sixteenth century. See Grendler (1975).

British system became the role model of copyright law. However, with its design and emphasis varying especially between common versus civil law countries.

In the end of the eighteenth century copyright legislation started to spread to the European continent and Colonial America. In Colonial America a resolution was passed by the Congress in 1783,[37] recommending that each of the 13 states adopt a law regarding the right to copy (Samuels 2000, p. 13; Raskind 1998, p. 478). Shortly after the so-called Connecticut's Statute of 1783, 12 states (excluding Delaware) adopted the copyright statute (Joyce et al. 2010, §1.03 B). The US Constitution of 1787, finally, gave the Congress the power to grant a temporary monopoly to authors and inventors to their respective writings and discoveries to "promote the progress of science and useful arts" (*US Constitution: Article 1, Section 8*).[38] Before, the protection of "literary property" had been a matter for the states (Ginsburg 1990, p. 999). The first national copyright law was signed by George Washington on May 31, 1790, with "An Act for the Encouragement of Learning"[39] (Samuels 2000, pp. 13 et seq.). As a matter of fact, the US Copyright Act of 1790 was almost verbatim copied[40] from the Statute of Anne and granted to each author of a map, chart[41] or book the right to exclude others from printing, reprinting, publishing or vending their work for two terms of 14 years (Samuels 2000, p. 12). In continental Europe, the evolution of national copyright law came to be distinguished from its Anglo-American counterpart.[42] The French Copyright Laws[43] of 1791 and 1793 did not only emphasize the "economic rights" that were recognized by the statutes of the common law jurisdiction, but added a second "autonomous set of non-transferable prerogatives identified as 'moral rights'" (Raskind 1998, p. 478). In particular, the "moral right" (droit morale) in French Copyright Law strengthened the personal

[37]The act was passed by the General Court of Connecticut under the title "An Act for the Encouragement of Literature and Genius" and is often referred to as the Connecticut's Statute. Other Pre-Constitutional statutes include for example the Massachusetts Statute among others. Several of these statutes prior to the US Constitution of 1787 particularly emphasize the "personal claims" of authors (Ginsburg 1990, p. 999; Joyce et al. 2010, §1.03 B).

[38]See http://www.law.cornell.edu/constitution/articlei#section8 (last accessed on September 1, 2014).

[39]By sharing almost the same title with the Statute of Anne, the closeness of both copyright laws seems to be already at hand.

[40]However, the US Copyright Law particularly emphasizes a purely utilitarian character for its copyright law. See also Sect. 2.1.2.

[41]Thus, the US Copyright Law added maps and charts as subject matters for copyright protection as compared to the Statute of Anne.

[42]See Geiger (2010a) on the influence of the Statute of Anne in France.

[43]Some historians see in the French decree of 1793 the world's first true Copyright Act. Bently (2010) argues that the Statute of Anne was referred to as a "right in copies" rather than a "right to copy" and hence applied rights to the printing and reprinting of books, but not copyright (Bently 2010, p. 9). Nevertheless, the influence of the British statute on other countries is uncontested (Cornish 2010; Geiger 2010a; Deene 2010). See the contributions of Bently and Kretschmer (2013) on https://copyrighthistory.org (last accessed on September 1, 2014) for a comprehensive collection of key documents and commentaries on the history of copyright.

claims of authors by emphasizing the intellectual and personal relationship of an author to her works. The French extension of copyright law included especially the right to the integrity of a work[44]—meaning the right to object any alteration, distortion or mutilation of a work (Raskind 1998, p. 478). The rights of publishers and the society as a whole were conceived as derivative rights. Besides, the duration of the copyright was extended to last for the authors' life time plus 10 years. In Germany the history of copyright eventually begins with enacting a copyright law in Prussia in 1837. The duration was first set at 10 years. In 1845 copyright legislation extended the term to authors' life plus 30 years. It was not until 1870, though, that the North German Confederation (Norddeutscher Bund) enacted a formal copyright regarding literary works, illustrations, musical compositions and dramatic works. After the formation of the German Empire in 1871, the copyright law of the North German Confederation was adopted and extended by complementary laws in 1876 (Eger and Scheufen 2012a, p. 165). Similarly to the French Copyright Law, the German copyright legislation emphasizes besides a property right in intellectual products (Immaterialgüterrecht) a separate set of rights referring to aspects of "personality" (Persönlichkeitsrecht), where the latter corresponds largely to the French "droit morale" dogma. Most importantly, a work is perceived to be personal in the sense that a work is infused with the personality of the author (Gassaway 2002, p. 40). As a result, the Anglo-American Copyright Law (Common Law System) and the Copyright Law in Europe (Civil Law System) followed different paths in the development of a copyright legislation, since the European model more specifically addresses an author's right to her personal creation.[45] Accordingly, the European system is often referred to as the "authors' and neighbouring rights" model (Raskind 1998, p. 478; Towse 2006, p. 84).

By the end of the nineteenth century copyright legislations had been enacted by an increasing number of jurisdictions. By then, a demand had been developed to coordinate copyright legislation at the international level. This is for at least two reasons: First, large differences between national legislations regarding its subject matters and its scope induced an environment of legal uncertainty for authors and publishers, respectively. Second, the territorial character of copyright, i.e. protection for "natives" only, gave rise to economic uncertainty as soon as cross-border transactions of copyrighted works became more important during the industrial revolution and hence the development of global markets.[46] After a period of bilateral

[44]Besides, the "moral rights" emphasize the right of attribution as well as the right to have a work published anonymously or pseudonymously.

[45]This difference is closely related to the philosophical debate between the utilitarian and the natural right school. See Sect. 2.1.2 for a discussion.

[46]In this regard, again technological change plays an important role. In particular, the invention of the steam engine by James Watt allowed for a reduction in transportation costs. In this context, Geller (2000) emphasizes that already during the eighteenth century "English novels crossed the Atlantic by steamship to be pirated in cheaper editions on the mass market in the United States" (Geller 2000, p. 233).

agreements between individual states, ten countries[47] formed a union for the protection of the right of authors in their literary and artistic works in 1886 in Berne, Switzerland—the so-called "Berne Convention".[48] In essence, the Convention was supposed to foster the governing of copyright at the international level in two ways: First and foremost, by signing the agreement each member state agrees to give the citizens of other member states the very same level of copyright protection as it gives to its own citizens. This general condition is referred to as the principle of national treatment (Berne Convention, Article 3-5). Second, the Convention sets a framework of minimum standards for copyright protection that may be interpreted as a signal for the copyright legislation in the countries, e.g. the minimum level for the duration of copyright is set at authors' life plus 50 years.[49] However, the "rule of shorter term" under Article 7(8) specifies that "unless the legislation of that country otherwise provides, the term shall not exceed the term fixed in the country of origin of the work" (Berne Convention, Article 7(8)), meaning that an author may not be granted longer copyright abroad than in his home country. Moreover, Article 9(2) of the Convention introduces a guideline for possible limitations or exceptions of copyright. In particular, the reproduction of a work is permitted "in special cases, provided that such reproduction does not conflict with a normal exploitation of the work and does not unreasonably prejudice the legitimate interests of the author" (Berne Convention, Article 9(2)) and is referred to as the (Berne) Three-Step Test.[50] In the following years the Convention was subsequently re-negotiated in 1896 (Paris), 1908 (Berlin), 1928 (Rome), 1948 (Brussels), 1967 (Stockholm) and 1971 (Paris) and amended on September 28, 1979.[51] Today 166 countries have signed the treaty, with a vast increase especially in the last two decades and the US joining on March 1, 1989.[52] Despite its general vision to become a universal framework, the Berne Convention remained a rather European initiative until at

[47]Belgium, France, Germany, Great Britain, Haiti, Italy, Liberia, Spain, Switzerland and Tunisia. Liberia was the only state that did not ratify the treaty in 1887.

[48]The full title is "Berne Convention for the Protection of Literary and Artistic Works". See http://www.wipo.int/treaties/en/ip/berne/trtdocs_wo001.html (last accessed on September 1, 2014).

[49]Nevertheless, the treaty does not delegate legislation to a supranational body. In particular, Article 2 of the Convention specifies that "it shall be a matter for legislation in the countries of the Union to determine the protection to be granted" (Berne Convention, Article 2).

[50]We will later reflect on the three-step test more carefully when analyzing the options for introducing OA publishing in the international copyright law framework. See Sect. 4.2.1.

[51]For instance, the three-step test under Article 9(2) of the Convention was introduced after the congress in Stockholm in 1967.

[52]While in 1970 the Convention counted 58 contracting parties, the number increased steadily to 70 in 1980, 83 in 1990, 147 in 2000 and 166 in 2013 (last accessed on September 1, 2014). See http://www.wipo.int/treaties/en/statistics/StatsResults.jsp?treaty_id=15&lang=en (last accessed on September 1, 2014). See http://www.wipo.int/treaties/en/ShowResults.jsp?lang=en&treaty_id=15 (last accessed on September 1, 2014) for a detailed list of the contracting parties of the Berne Convention.

least the mid twentieth century.[53] As a matter of fact, two distinct systems coexisted: The Berne Convention (European System) and the Buenos Aires Convention (Inter-American System).[54] Signed by the US and nineteen Latin-American countries[55] in 1910, the Buenos Aires Convention (Article 3) introduced the obligation to a state that all rights are reserved as a necessary condition for maintaining copyrights (Lipszyc 2010, p. 386). Under the Convention copyright protection was granted for the shorter of the terms of either the protecting country or the source country of the work—referred to as the rule of the shorter term, stated in the Articles 6 and 7 of the Convention. However, besides the vage formulation of several provisions of international copyright law, the Convention particularly suffered from the absence of Argintina and Chile until the 1950s (Lipszyc 2010, p. 386). By then the UNESCO had developed a Universal Copyright Convention that was adopted in Geneva in 1952, giving those countries some form of multilateral copyright protection that still disagreed with the "European model" of the Berne Convention. In particular, the US followed a totally different path than the Berne Convention, since US copyright protection was subject to the registration of a work at the Copyright Office and granted for a fixed and renewable term. The Berne Convention instead asked for the very opposite. The need for several structural modifications in their copyright law and economic interests made the US to refuse to join the Berne Convention (Eger and Scheufen 2012a, pp. 165 et seq.). Besides, several other countries—especially the developing world and the Soviet Union—believed that the Berne Convention and the extensiveness of the copyright system would primarily benefit the western world. The conflict of the different copyright systems, finally, lead to the foundation of the World Intellectual Property Organization (WIPO) in 1967.[56] The WIPO was generally thought to mediate between the conflicting interests and quickly turned to a specialized agency of the United Nations in 1970. The fact that the US finally refrained from their "registration constraint", joining the Berne Convention in 1989, may be seen as a success of the WIPO initiative. With the advent of the World Trade Organization (WTO) in 1994, the basic aspects of the Berne Convention were integrated to Article 9 of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and became binding to all member states of the WTO. The TRIPS-Agreement as such does not only cover copyright issues, but sets standards

[53]The fact that a French statesman and literate, named *Victor Hugo*, initiated the development of the Berne Convention emphasizes the French influence to formulate the principles of the agreement in Berne. As such, the "moral rights" principle is explicitly accounted for under Article 6 of the Convention.

[54]See Lipszyc (2010) for a review.

[55]Argintine Republic, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Haiti, Honduras, Mexiko, Nicaragua, Panama, Paraguay, Peru, Salvador, Uruguay and Venezuela. For the Convention see http://ipmall.info/hosted_resources/lipa/copyrights/The (last accessed on September 1, 2014).

[56]The WIPO is based in many respects on the United International Bureaux for the Protection of Intellectual Property that was set up in 1893 when the bureaus that administered the Berne and Paris Convention had merged. See May (2009) on page 17.

and requirements for all forms of (formal) intellectual property rights, including patents, copyrights, trademarks etc. In particular, the minimum standard for the duration of copyright protection is set at author's life time plus 50 years, where no registration is required. Most importantly, the TRIPS-Agreement ensures that no discrimination of states with respect to non citizens is possible, as each state has to treat its citizens and the citizens of other TRIPS countries likewise.[57] Despite all efforts in harmonizing standards for copyright protection, national legislations remain to be responsible for its design. As a consequence, there is no such thing as an international copyright law.

In the twentieth century the terms of copyright was steadily extended by national (and international) reforms, regarding both the duration and the scope of copyright. In particular, two general reasons abound for these changes in copyright law: (1) technological change and (2) rent-seeking. First and foremost, the development of new technologies to produce, copy and distribute copyrightable works induced a new environment for competition between the original and the copy. The technology to print books remained rather unchanged until the twentieth century. The rotary press had mechanized the process of automatic paper delivery. However, most of the known printing technologies still required laborious workflows, like the type setting and particularly the transfer of ink to paper by pressing the paper against a plate (Samuels 2000, p. 17). In 1938, Chester F. Carlson introduced a fully new printing technology with the dubbed xerography (from Greek *xeros* "dry" and *graphia* "writing"), an electrostatic dry-printing process.[58] Nevertheless, the new technology was first rather thought of as an alternative printing process until the advent of the Xeros 914 copier in 1959, easing the making of copies of printed material dramatically and triggering a series of significant revisions in the copyright laws. While the impact of the photocopier turned out to be rather small for traditional entertainment works,[59] like books (novels etc.), newspapers, magazines etc., it revolutionized the dissemination of scholarly journals by copying en masse from library collections.[60] The conflict between journal publishers and

[57] See http://www.wto.org/english/tratop_e/trips_e/t_agm0_e.htm (last accessed on September 1, 2014) for the TRIPS-Agreement.

[58] In particular, Carlson combined electrostatic printing with photography. As such, the dark parts of a picture are negatively charged, whereas the light parts lose their charge by exposure to light. Consequently, the positively charged toner powder sticks to the darker parts of the picture. In a final step, a heater seals the toner on the paper (Samuels 2000, p. 18). See Owen (2004) for a comprehensive analysis of the impact of the Xeros copier for the printing industry.

[59] The reason is rather easy to grasp. First, the copying of a complete novel requires labor and time and hence is not necessarily cheaper than its original. Second, the quality of a copy of a novel and the convenience for its use make it to be no perfect substitute for the original.

[60] Sung et al. (2009) provide with general facts and a description of the impact of photocopying on the copyright industries as well as with links for further reading via http://blogs.ischool.berkeley.edu/i103su09/structure-projects-assignments/research-project/projects-and-presentations/copyright-and-the-advent-of-xerox-machines/ (last accessed on September 1, 2014). In Sect. 2.1.2 we will further elaborate on this issue by introducing to the economics of copying.

libraries, finally, led to a number of court cases[61] and especially induced the codification of the "fair use" principle in the US Copyright Act of 1976.[62] In particular, the Copyright Act of 1976 specified exemptions for the photocopying by libraries and archives and allowed the copying of copyrighted works for teaching purposes. Besides, the US adopted a unitary term based on the date of the author's death.[63] Subsequent amendments to US Copyright Law—like the Semiconductor Chip Protection Act of 1984 and the Vessel Hull Design Protection Act—further broadened the scope of copyright protection to new subject matters as new product technologies were developed.[64] The advent of the internet (more particular the World Wide Web) in 1989, finally, somehow revolutionized the making of copies and hence the conditions in the markets of copyrighted works. In particular, two parameters in the copyright "equation" changed: On the one hand, with digital technologies the costs for making copies are almost zero.[65] On the other hand, the quality loss of earlier copying technologies is eliminated with significant consequences for competition, since original and digital copy are perfect substitutes (Wiebe 2010, p. 323; Eger and Scheufen 2012b, p. 50). The new challenges in the digital environment quickly induced a debate in the international forum. In 1996, the WIPO adopted two treaties, the "WIPO Copyright Treaty"[66] and the "WIPO Performance and Phonogram Treaty",[67] clarifying copyright on the internet (Samuels 2000, p. 111). On the national level, the US Digital Millennium Copyright Act of 1998 and the EU Copyright Directive of 2001 followed. In particular, the changes made in copyright legislation were related to the development of "Digital Rights Measurement" (DRM) technologies (sometimes referred to as technological protection measurements), i.e. software which virtually enables the controlling of

[61] These include e.g. *Williams & Wilkins Co. v. United States* (1973), *Encyclopedia Britannica Educ. Corp. v. Crooks* (1978), *Basic Books Inc. v. Gnomon Corp.* (1980) and *Addison-Wesley Publishing Co. v. New York Univ.* (1983).

[62] The "fair use" doctrine was not unknown before its codification under section 107 in 1976, as the federal courts had applied the common law form of this doctrine since the 1840s.

[63] As previously mentioned, the US Copyright Law was until then based on a fixed initial and renewal term.

[64] The development of new technologies also affected other fields of the copyright industry. As such, the invention of the video recorder (Betamax) and later DVD players induced significant changes for the film industry. See for example Gordon (1982) for an analysis of the Betamax Case or Mortimer (2007) on DVDs. Similarly, the impact of new tape recording technologies (records, tapes, CDs and later MP3) for the music industry. In this context, the US Congress introduced a new amendment in 1972, involving two separate copyrights for music (for the composer) and sound recordings (for the record company). See also Samuels (2000).

[65] This aspect is closely connected to a third new environmental condition in the digital era, i.e. digital information can be distributed without the need for any physical medium such as paper or a CD (Eger and Scheufen 2012b, p. 49).

[66] See http://www.wipo.int/export/sites/www/treaties/en/ip/wct/pdf/trtdocs_wo033.pdf (last accessed on September 1, 2014).

[67] See http://www.wipo.int/export/sites/www/treaties/en/ip/wppt/pdf/trtdocs_wo034.pdf (last accessed on September 1, 2014).

access, use and trading of electronic content (like movies, music etc.). In this regard, the changes made to national copyright strengthened the positions of DRM advocates and made it illegal to bypass DRM technologies, even "if the person doing so would otherwise have the legal right to access the information behind the digital fence" (Corrigan and Rogers 2005, p. 168). This "fencing off" of information, finally, induced a debate upon the "information commons" and countermovements to the traditional copyright system with the "Creative Commons" (CC) movement introduced by Lawrence Lessig or the Google Book Search Project.[68] Second, also rent-seeking motives have significant explanatory power for the gradual strengthening of copyright legislation. As such, the extension of the copyright term to 70 years after the author's death with the Sonny Bono Copyright Term Extension Act (CTEA) in 1998, is a classical example of how economic interests can shape the law. In particular, the Sonny Bono Act was decisively lobbied by Walt Disney, as the first drawings of Mickey Mouse would have entered the public domain in 2003 without an extension of the copyright term (Lévêque and Méniére 2004, p. 68; Corrigan and Rogers 2005, p. 164).[69]

In the end, this series of revisions on the copyright laws—due to new media and copying technologies as well as lobbying activities by the parties who are exploiting the copyrights of the creator (publishers etc.)—have extended the copyright in terms of its duration and its scope, especially regarding the capable subject matters. After extending the copyright term in 1831 to 28 years, renewable for 14 years, and again in 1909 to 28 years, renewable for another 28 years, the US Congress extended the term for 1 year each year after 1962. From 1976, the renewal term for "old" works was set at 47 years and extended to life of the author plus 50 years for new copyrighted works (Corrigan and Rogers 2005, p. 156). With the Council Directive 93/98/EEC of October 29, 1993,[70] the EU harmonized the term to author's life time plus 70 years, with the US following with the Sonny Bono Act in 1998. At the same time new subject matters had to be defined due to the development of new media technologies. As the principle of copyright originates in the technology of the printing press, the "right to copy" was first considered as a right in books only. The enactment of the US Copyright in 1790, finally, broadened the scope to include also maps and charts. Throughout the nineteenth century several new subject matters were added by the US Congress, broadening the scope e.g. to musical compositions (1831), dramatic works (1856) and photography (1865). With the Copyright Act of 1976, finally, the Congress included a phrase to more abstractly define copyright's subject matter as "works of authorship" (17

[68] See Sect. 2.1.3 for a discussion of the counter movements as reactions to the broadening of copyright protection. For a seminal work on the idea of "Creative Commons" see Lessig (2004). A law and economics analysis of the Google Book Search Project is Mueller-Langer and Scheufen (2011b).

[69] On rent-seeking in the UK copyright legislation see Mitra-Kahn (2011).

[70] See http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0098:EN:HTML (last accessed on September 1, 2014).

U.S.C. §102(a)) regardless of a work's medium of fixation (Hardy 1999, pp. 663 et seq.). By this generalization of copyright's subject matter, the Congress strived for a more flexible framework to respond to and accommodate the development of new media technologies. As a matter of fact, section 102(a) of the US Copyright does not specifically name computer programmes as a subject matter of copyright. The German "Urheberrecht", in contrast, explicitly lists computer programmes under §2(1) UrhG. Thus, the copyright has always been a matter of change as new technological developments and economic interests kept driving the system to continuously adapt to changing conditions. Economic theory, meanwhile, has been providing with the necessary tools for evaluating the impact of possible changes for the effectiveness of the copyright system. The following section shall introduce to the analysis of copyright from an economic perspective.

2.1.2 The Economics of Copyright and Copying

Legal and Economic Philosophy

The conceptual origins of the system of intellectual property rights in general and copyright in particular can be traced back to the debate of primarily two distinctive philosophical schools: The utilitarian school (Jeremy Bentham, John Stuart Mill, Thomas Jefferson) and the natural rights school (John Locke and Jean-Jaques Rousseau).[71] While utilitarism emphasizes the relevance of the interplay between individuals—standing on the shoulders of one another—and hence perceiving an invention as a product by society in a cumulative process of producing intellectual assets, the natural rights approach strengthens the position of each individual's contribution in advancing the knowledge base of the society. As such, the utilitarian notion of intellectual property argues that intellectual creations are creations by society and as such should serve the interests of all members at large (Granstrand 1999, p. 24; Menell 1999, pp. 130 et seq.; Eger and Scheufen 2012a, p. 153). Or as Thomas Jefferson frames it: "Inventions then cannot, in nature, be a subject of property. Society may give an exclusive right to the profits arising from them, as an encouragement to men to pursue ideas which may produce utility, but this may or may not be done, according to the will and convenience of the society, without claim or complaint from anybody." (cited in David 1993, p. 26).[72] Following the line of argumentation by the natural rights school, in contrast, each individual is perceived of having a natural claim to the results of his or her physical or mental labour (Granstrand 1999, p. 23). And hence, there is essentially no difference

[71] The list may be even broadened to contributions by David Hume, Immanuel Kant and Friedrich Hegel among others, who indirectly influenced our present notion of intellectual property (Granstrand 1999, pp. 23 et seq.). See Palmer (1990) for further reading.

[72] See also Granstrand (1999) on pages 34 et seq.

between property in physical or intellectual creations. In particular, the natural rights school argues that any result from individual's intellectual labour may and should be perceived as an extension of that individual's identity, "an extension of which the individual could not be deprived by others, and especially not by societal institutions" (Granstrand 1999, p. 23). Or more generally speaking and following Locke (1689) it is the notion that all humans possess an unquestionable property in their own person (Menell 1999, p. 157).

In the historical evolution of the copyright system—as well as of the system of intellectual property rights in general—the influence of natural rights arguments eventually declined. As a consequence, the "modern" twentieth century copyright system can be seen rather in the tradition of the utilitarian argumentation, while considerable differences regarding its perception can be found in comparing the Anglo-American and European copyright system. As such, especially for the development of copyright in the United States the utilitarian notion of intellectual property became an essential principle. Menell (1999) cites a report by the Congressional Committee on the 1909 US Copyright Act which thoroughly highlights the utilitarian position by the Congress. Here it says: "The enactment of copyright legislation by Congress under the terms of the Constitution is not based upon any natural right that the author has in her writing [...] but upon the ground that the welfare of the public will be served [...] by securing to authors for limited periods the exclusive right to their writings." (*US Copyright Act (1909)*). The copyright systems in Continental Europe, in contrast, explicitly account for the natural rights argument as they eventually distinguish between economic and moral rights.[73] As previously outlined, the German copyright legislation, for instance, distinguishes between a proprietary right in the intellectual product—Immaterialgüterrecht—and a separate form of rights regarding the creator's personality—Persönlichkeitsrecht (Raskind 1998, p. 478).

Theoretical and Normative Foundation

A systematic analysis of copyright from an economic theory perspective, meanwhile, had long been a neglected topic in economics and is much younger as the system of copyright itself. While first comments on copyright issues may be traced back to early economists like Adam Smith,[74] it was not until the seminal work by

[73]Throughout the process of harmonization by means of international treaties the differences have clearly diminished over time (Reichman and Okediji 2012, p. 1377). In this regard, Goldstein (2001) finds that the differences between the two traditions are more in terms of emphasis than outcome. Ginsburg (1990) highlights that both the French and US Copyright law exhibit a mix of both traditions.

[74]Smith approaches the issue of intellectual property by making a case for temporary monopolies that are justified and reasonable (in contrast to "unjust" monopolies). In his "Lectures on Jurisprudence 11" Smith already distinguishes the exclusive privileges, like patents and copyrights, from other forms of property. In this context, Smith postulates that "the author of a new book

Plant (1934) to establish a research field that may be called "the economics of copyright" (Towse et al. 2008, p. 1; Watt 2004, p. 153). As such, Plant's article marks the launch of a broad scientific literature on the economics of copyright, whereas subsequent works primarily approached the issue of copying.[75] However, only after the early 1970s—where the work by Breyer (1970) may be perceived as most influential—economists started to regularly contribute to the advancement of the literature in the economics of copyright and copying, respectively (Gordon and Bone 1999, p. 192).[76] As most important for laying the foundation of modern copyright analysis can be seen the work by Landes and Posner (1989). The authors provide a first comprehensive analysis regarding the various doctrines in copyright law, making reference to explicit aspects like the duration and the scope of copyright protection as well as on the fair use doctrine in US Copyright Law (17 U.S.C. §107). Furthermore, Landes and Posner (1989) were first to distinguish analytically between the fields of the "Economics of Copyright" and the "Economics of Copying". A distinction that has since been frequently adapted and has become standard in the economic literature.[77] The usefulness of distinguishing between copying and copyright issues is based upon a difference in the analytical focus of each field. While the economics of copyright primarily focuses on problems referring to the legal framework and hence a legal question, the economics of copying analyze problems which are related to advances or changes in the technologies for reproduction (Towse et al. 2008, p. 9).[78] Despite the breadth of topics being analyzed in the literature on the economics of copyright and copying, two general approaches can be highlighted to form the basis of the traditional analytical framework in law and economics: (1) The Public-Goods Approach and (2) The Property-Rights Approach.

In this regard, the economic rationale for providing legal protection for works in arts, literature and science by means of copyright—as an exclusive right—is

has an exclusive privilege of publishing and selling his book [...] as an encouragement to the labours of learned men." (Meek et al. 1762, p. 83). See Hadfield (1992) on pages 11 et seq. for a comprehensive review on the history of the economics of copyright.

[75] Obviously, copying is closely related to copyright, since copyright is designed to control copying (Watt 2004, pp. 159 et seq.). Seminal works on the economics of copying can be traced back to articles by Hurt and Schuchman (1966), Breyer (1970), Novos and Waldman (1984) and Johnson (1985). A more recent article on this topic is Varian (2005). See Towse et al. (2008) for a comprehensive literature review.

[76] Note that by then relevant contributions on the economics of public goods by Samuelson (1954) and information economics by Arrow (1962) and Stigler (1961) provided with the necessary tool kit for approaching the problems in the market for information goods. See also Gordon and Bone (1999) on page 192.

[77] See for example Varian (2005).

[78] Obviously, copyright and copying are often interrelated and can, as such, not always be strictly distinguished. Nevertheless, a distinction between the two fields seems useful and reasonable as they differ with respect to the problem that is being analyzed. As such, we will proceed by also distinguishing between the "Economics of Copyright" and the "Economics of Copying".

ultimately determined by the nature of the market for information goods. From an economics perspective information goods exhibit the classical characteristics of a public good,[79] characterized by non-rivalry and non-excludibility (Gordon and Bone 1999, pp. 191 et seq.; Koboldt 1995, p. 133; Eger and Scheufen 2012a, p. 154). Accordingly, book contents or musical compositions, respectively, can be copied or used at will without affecting the amount and quality being consumed by others (non-rivalry). In addition, information goods impose high transaction costs for identifying and excluding other market participants from consuming the good (non-excludibility).[80] That is, the public good character finally induces an incentive to consume the information good without bearing the (sunk) costs of production—in the sense of the opportunity and risk costs by the creator. As a consequence, a fundamental free-riding problem (prisoner's dilemma)[81] emerges with "copying" as the dominant strategy, inducing a divergence between private and social incentives to innovate and hence an underprovision of information goods, as the creator has to fear not being able to recoup her sunk costs of actually producing the good (Arrow 1962). The concept of copyright law offers a solution to eventually overcome this free-riding problem by providing the creator of a work with an exclusive right that enables her to exercise control over the use of her works and hence providing ex ante with an expectation to internalize an economic surplus—or at least to recoup her sunk costs.[82] That is, the Public-Goods Approach provides a general argument to justify the "privatization" of intellectual creations by referring to the need to create incentives for creative activities (Demsetz 1970; Gordon and Bone 1999, pp. 192 et seq.).

The Property-Rights Approach complements the Public-Goods Approach by providing a tool box for designing the principles of copyright law in view of the criteria of economic efficiency. As conceptually most important in this context may be seen the works by Ronald H. Coase and particularly the Coasian bargaining

[79]The public good character of information (goods) was first to be acknowledged by Saint Augustine, sometime between 391 and 426 (Wills 1999) and later by Thomas Jefferson in 1813 (Dalrymple 2003).

[80]The notion "public good" in this context may sometimes also be perceived somewhat misleading. In this regard, Landes and Posner (2003) emphasize: "It sounds like a good produced by the government as opposed to the private sector. That is true of public goods that people cannot be excluded from having the benefit of even if they don't contribute to the cost of supplying the goods. The clearest example is national defense. Many public goods, however, including intellectual property, are excludable in the sense that it is possible to condition access to them on payment." (Landes and Posner 2003, p. 14).

[81]The prisoner's dilemma game in the market for information goods is analyzed by Gordon (1992a). She shows that in a game where the players may choose between creating a work on their own or simply copying the work of another, the strategy of copying will strictly dominate the creation. As a result, no work is being created. See also Gordon and Bone (1999) on pages 192 et seq.

[82]Obviously, the economic arguments for justifying copyright protection are closely related to the theory of externalities (Heide 2004). In this respect, the public good theory is only part of a much broader theory of externalities.

solution. Following Coase (1960), an efficient allocation will be reached by a bargaining between the players (creator and user) regardless of whether player 1 or player 2 is entitled with a property right. As a necessary condition for this market solution, however, Coase (1960) emphasizes the relevance of well-defined property rights and the absence of transaction costs. But, especially in the market for information goods transaction costs are by nature rather large. The reason and inevitable consequences are rather easy to grasp. Imagine a situation in which every market participant would be entitled with a natural right to copy a work. Then, every creator would have to contract with everyone who had access to the work. Obviously, a situation that would not lead to a Pareto-efficient outcome due to high information costs (Gordon and Bone 1999, pp. 193 et seq.; Gordon 1992b, 1989). However, the same may be true when multiple and dispersed users of a work would have to contract with the creator to receive the permission to use a particular work. A condition that may explain why in copyright law the tradition of enforcing a "property rule" is frequently replaced by the concept of a "liability rule", where a user may use the work without permission and instead pays a fair price that is set by a third party (collecting society). In this context, Calabresi and Melamed (1972) showed that with increasing transaction costs it may be reasonable to shift from a "property rule" toward the more flexible concept of a "liability rule".[83] The principle of "flat tax compensation" (pauschale Vergütung) can be viewed in the tradition of this basic economic insight. The Property-Rights Approach, finally, provides with the instruments to specify the property rights between the rightholder and the user, giving reasoning to a welfare maximizing design of the copyright system. As such, the economic analysis of copyright law (as well as the system of intellectual property rights in general)[84] manifests in a classical maximization problem from a social welfare perspective (Eger and Scheufen 2012a, pp. 155 et seq.). The optimal design of copyright law will be addressed in the following section.

The Economics of Copyright

The basic economic intuition behind copyright is somewhat twofold. First, a state may choose to grant an exclusive right to the author of a work to overcome the market failure associated with the provision of a public good. Thus, copyright is designed to control copying activities to prevent from an underprovision of information goods in the context of the free-riding environment. The exclusivity in this regard gives the rightholder the market power (in the sense of a temporary

[83]Especially due the technological revolution ushered in by the internet and the vast increase in opportunities in the digital environment, a debate on a shift in paradigm in favor of a "liability rule" has been induced (Eger and Scheufen 2012a, p.155). See also Lemley and Weiser (2007).

[84]For an overview on the economics of intellectual property rights see for example Besen and Raskind (1991) besides Posner (2005). A brief overview in German language is provided by Mueller-Langer and Scheufen (2011a).

monopoly) to increase the product prices above marginal costs and hence to generate profits which serve as an incentive to engage in creative activities ex ante. Second, as copyright restricts access to information goods, it creates economic costs (deadweight loss). Copyright therefore should be limited in so far, as to guarantee that creative works are created at minimum costs (Landes and Posner 1989; Besen and Raskind 1991, p. 5). In particular, easing access to basic or prior creations in a cumulative environment of knowledge production—i.e. in an environment where each creator is "standing on the shoulders of giants" (Turnbull 1959)—may be relevant to foster not only innovations today, but also tomorrow. In so far, copyright should be limited to foster the dissemination of new ideas, building the foundation of creative works tomorrow (Eger and Scheufen 2012b).[85]

The economic analysis of copyright, finally, reflects on this basic trade-off between creating incentives to innovate (*benefit argument*) and restricting access to information (*cost argument*).[86] In this context, Landes and Posner (1989) describe copyright law as an attempt to balance a conflict of interest between the parties on the supply side (creators and publishers) and the demand side (users) of the market. While the creator and publisher of a copyrightable work seek for an extension of copyright protection to force an internalization of the economic surplus, the consuming entities aspire for a cheap or free (open) access to the good. From economics perspective this conflict of interests manifests in a classical maximization problem, maximizing the difference between the benefits of providing incentives for authors to create a work and the costs associated with a limitation of its access (Landes and Posner 1989, p. 326; Mueller-Langer and Scheufen 2011a, p. 140; Hilty and Peukert 2004). In designing an optimal copyright law, a social welfare analysis generally distinguishes three dimension of copyright protection: (1) Duration, (2) Depth or Height and (3) Breadth (Varian 2005, p. 124; Watt 2004, p. 157; Eger and Scheufen 2012a, p.157).[87]

The first dimension, the duration of copyright refers to the time horizon and hence the amount of years copyright protection is enforced for (Watt 2004, p. 157). In this respect, most (developed) states of the world grant copyright protection for 70 years after the death of the author (Eger and Scheufen 2012b). Recent reforms in copyright law—e.g. the US Sonny Bono Copyright Term Extension Act (CTEA) in 1998 or the guidelines 93/98 EWG for a harmonization of EU copyright law to 70 years—have extended the length of copyright protection. The minimum standard

[85] As such, copyright can be seen as a form of social contract, where the public agrees to a law to ensure creative development for the benefit of following generations, but the costs of having to pay a higher price today.

[86] Accordingly, the economics of copyright joins the tradition of the IPR argumentation and hence trades off between underproduction and underconsumption of information goods due to the divergence between private and social incentives to innovate (Arrow 1962).

[87] There are several works on the optimal structure of copyright, where some papers even predate the seminal paper by Landes and Posner (1989) by a few years. See, for example, Novos and Waldman (1984), Pethig (1988) or Besen and Raskind (1989). See also Liebowitz and Watt (2006) on pages 516 et seq. for a review.

has been fixed by international agreements (e.g. TRIPS, WIPO Copyright Treaty) to author's life time plus 50 years. Landes and Posner (1989) provide with insights to the intertemporal trade-off coinciding with a lengthening of copyright protection. As copyright grants an exclusive right to the author—thereby preventing others from copying—copyrightable works are removed from the public domain for the duration of copyright, increasing the costs for subsequent or derivative works. Accordingly, an extension of its duration is only reasonable if its discounted positive effects for creations today (static efficiency) manage to compensate its negative effects on the incentive to create (subsequent) works tomorrow (dynamic efficiency), marking a social equilibrium where marginal costs equal marginal benefits.[88]

Both latter dimensions refer to the depth and breadth of the protection, clarifying the aspects of a work that are protected and giving advice to uses being considered as an infringement of copyright law (Watt 2004, p. 157; Landes and Posner 1989, pp. 347 et seq.). As the depth of copyright is concerned, the law provides only protection to the expression, but not the idea expressed by the author. We have seen that copyright protection is much narrower than a patent, since a patent grants a monopolistic right regarding a (complete) technology and hence the idea of an innovation. In contrast, following section 102(b) U.S.C. the same idea may be expressed differently without infringing copyright law. With other words: The ideas expressed in this chapter on the economics of copyright in my own words does not state an infringement of the copyright by the pioneers in this field.[89] Whereas copying a portion or the whole article without reference to the pioneering authors would turn me to an infringer.[90] The breadth of copyright is mainly limited by fair use in US Copyright Law (17 U.S.C. §107) or in the European Copyright Laws (in Germany: §§44-63 UrhG) by a catalogue of exceptions.[91] As previously outlined these limitations and exceptions refer to certain special cases which allow to use a work without the permission of the rightholder.[92] We have seen that especially

[88] As such, the considerations on the optimal duration of copyright just follows the basic arguments expressed in the model of Fig. 2.1.

[89] Obviously, especially in science, where priority to a discovery, eponymy and hence citations are considered as the currency of the market, a reference to prior and seminal works is essential and still required. However, this is rather an issue of the moral or personal rights of the author but copyright. See Sect. 2.2 on the economics of science. A seminal work on the economics of science is Merton (1973) (earlier works include Merton (1948) and Merton (1968)) besides Freedman (1960).

[90] See Landes and Posner (1989) on pages 349 et seq. for a discussion on "distinguishing ideas from expression".

[91] The fair use doctrine (US Copyright Law) and the catalogue of exceptions (European Copyright Laws) follow various public goals such as freedom of speech, educational and equality of access as well as issues referring to market failures. See e.g. Hugenholtz (2001).

[92] Following the Fair Use Doctrine (17 U.S.C. §107) four statutory factors help courts to assess whether a use is considered to be "fair" and hence non infringing: (1) the purpose and character of the use, (2) the nature of the copyrighted work, (3) the amount and substantiality of the portion used and (4) the effect of the use upon the potential market for and value of the copyrighted work. See Gordon (1982) on the economics of fair use. Mueller-Langer and Scheufen (2011b) provide a recent analysis of the Google Book Search Settlement under fair use considerations.

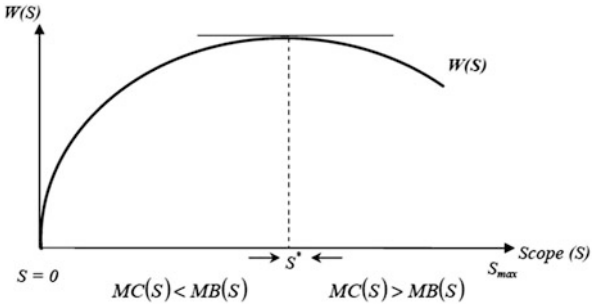

Fig. 2.1 The optimal scope of copyright (*Source*: Mueller-Langer and Scheufen (2011b))

for educational purposes—like research and teaching—a general "fair use" defense is implemented. In scientific research, especially the rights to cite and adopt expressions from other authors constitutes a crucial barrier of copyright protection, explicitly taking into account the cumulative character of scientific research and facilitating the creation of derivative works. Other categories refer to issues like the private copy, home recording of musical compositions, parody, criticism, comment, news reporting, archiving etc. In the literature the dimensions of depth and breadth are often bundled under the title "copyright scope" (Watt 2004, p. 157).

In this respect, some simple economics may eventually explain the underlying rationale regarding the optimal scope of copyright protection.[93] Landes and Posner (1989) already emphasize the relevance of a minimum standard of copyright protection. However, a "too much" of protection—in the extreme case considering every use as an infringement of copyright—forces a situation where an extension in the scope of copyright would lead to marginal costs (MC) exceeding marginal benefits (MB). The economics of this rationale are just straightforward. To see this, consider the following simplified argument. Let $W(S)$ denote the social welfare subject to the scope (S) of copyright, where $\frac{dW(S)}{dS} \geq 0 \forall S \in [0, S^*] \wedge \frac{dW(S)}{dS} < 0 \forall S \in]S^*, S_{\max}]$, with S^* revealing the optimal scope satisfying for a maximization of the social welfare $W(S)$. Accordingly, in S^* we satisfy the condition that $\frac{dW(S)}{dS} = 0$ and hence that $MB(S^*) = MB(S^*)$. Geometrically this optimal scope is displayed by the horizontal tangent to $W(S)$, leaving us with a maximum in S^* since $W(S)$ exhibits the characteristics of an inverted u-shape. Figure 2.1 illustrates this rationale in the optimal scope of copyright (Mueller-Langer and Scheufen 2011b, pp. 13 et seq.).[94]

Obviously, there is an optimal scope of copyright, since the social welfare is not strictly increasing in S, such that $S^* < S_{\max}$. Consequently, a use will be expected to infringe copyright as long as a protection of this particular use comes along with a positive net gain in social welfare. In contrast, the scope is not broadened to uses that are to the right of S^*, since an extension would cause a decrease in social welfare

[93]The following (simplified) model is taken from Mueller-Langer and Scheufen (2011b).

[94]Note that the graphic as well as the technical arguments break things down to an ideal type of the relationship between scope and economic returns.

from copyright. Accordingly, an adjustment and optimal definition of the scope of copyright will have to balance the costs and benefits following the economics of this simple model. A closer look at the rationale already emphasizes the differences in the flexibility regarding the two competing copyright principles. While the fair use doctrine (17 U.S.C. §107) in the US Copyright law explicitly accounts for a balancing of the costs and benefits of a single use of copyright material in the context of a case by case analysis, the European tradition explicitly lists the exceptions which are considered as "fair uses". Thus, the US fair use doctrine is much more flexible. A condition that particularly gains relevance in an environment of vast structural changes in the presence of technological change.[95]

However, consciousness is needed regarding the calculus of an optimal design of copyright as each of the three dimensions may not be viewed separately. In particular, a comprehensive analysis will have to consider all possible interdependencies between these dimensions. An optimal mix of all dimensions involved will then create another dilemma in copyright law due to high information needs as well as a very fine line between the relative optimality of the three dimensions (Watt 2004, p. 157).[96]

The Economics of Copying

While the Economics of Copyright approaches the problems associated with the supply of information goods by analyzing the effects of public intervention (copyright law) only, the Economics of Copying more generally addresses the effect of copying in an environment of technological change, providing with a framework to specifically discuss alternative mechanisms to copyright law (Handke 2010, p. 31; Towse et al. 2008, p. 9). As such, the Economics of Copying builds a bridge to the changing environment for copying as new technologies are developed. The previous reflection on the history copyright clearly emphasizes that the development of new copying technologies—since the advent of the Xeros copier in 1959—have eased the copying of copyright material in terms of costs, quality and time effort. Given this framework, the Economics of Copying analyzes the relation between the right holders' costs for generating copies of a given work, and the costs of unauthorized copying (Handke 2010, p. 31).[97] In this regard, Besen (1986) shows that unauthorized copying may lead to a loss of social welfare, if economies of

[95] See Sect. 2.1.3 for a closer look.

[96] Watt (2004) (on pages 157 et seq.) provides a formal model on the optimal design of copyright, clearly emphasizing a dilemma with respect to the optimal mix of the three dimensions in copyright law. In particular, he shows that there is no unique solution for minimizing the deadweight loss subject to the participation constraint of the author.

[97] Another trade-off that is being analyzed in the literature on the economics of copying can be traced back to the nature of the cost structure of information goods, i.e. copyrighted works are characterized by high fixed costs of creating the work in the first place but rather low marginal costs of generating multiple copies of a given work. See particularly O'Hare (1985) and Pethig

scale can be observed in the copying of a copyrighted work. However, this trade off may be less important in an environment of digital technologies, where the costs of copying are reduced to virtually zero.

In particular, the works by Stan Liebowitz in the 1980s led to a somehow revolutionary notion of copying activities.[98] While until that time copyright was rather perceived as the battle against (unlawful) copying of works of authorship,[99] Stan Liebowitz forwarded an idea that was entitled indirect appropriability and seen as an alternative to the public intervention in the market for information goods (Handke 2010, p. 33).[100] Historically seen, the papers by Liebowitz and his followers may be seen as a reaction on the vast increase of court cases after the advent of the Xeros 914 copier in 1959. The new copying technology most significantly affected the market for academic journals as it became common practice to copy single journal articles or complete issues en masse from (university) library collections.[101] Liebowitz (1985) argued that particularly in the case of academic journals[102] the ability of photocopying increased the value of a given piece of work and hence the willingness to pay. As a matter of fact, he showed that unauthorized copying could eventually allow sellers of originals to capture this additional value by the simple

(1988). A more recent analysis is Pollock (2007). See also Handke (2010) on pages 31 et seq. and Towse et al. (2008) on pages 9 et seq.

[98]Liebowitz (1981) published a booklet in 1981 that created the fundament for a series of papers, analyzing the impact of reprography on the copyright system. The concept of indirect appropriability follows particularly from Liebowitz (1985, 1986). See also Liebowitz (1983).

[99]Liebowitz (1985) provides with a quote by the publishing house "Williams and Wilkins Company" to illustrate the notion of publishing houses towards the impact of photocopying on the journal publishing market. They argue that "uncontrolled photocopying is largely responsible for the deaths of two journals [...] and if the condition is allowed to continue, many more will either go out of business or be published under government subsidy." (Liebowitz 1985, p. 956; as quoted in Thatcher 1978, p. 324). As we will see later, this topic has not lost it's topicality in the digital (Open Access) environment.

[100]Liebowitz's famous paper on indirect appropriability was published in the Journal of Political Economy in 1985. Together with the papers by Novos and Waldman (1984) and Johnson (1985) in the same journal and around the same time, the paper induced a flood of new papers reflecting on the economics of copyright and copying (Watt 2005, p. 1). In 2005, the Review of Economic Research on Copyright Issues published a series of papers in a symposium for the twentieth anniversary of the concept of indirect appropriability. Here, Liebowitz (2005), Johnson and Waldman (2005), Johnson (2005) and Boldrine and Levine (2005) reflect critically upon indirect appropriability in the context of technological change.

[101]See Sect. 2.1.1 for short review. In particular, see Liebowitz (1981, 1983) besides chapter one in Samuels (2000).

[102]Liebowitz (1985) was rather sceptical about a generalization of the concept of indirect appropriability for other markets but the academic journal market. He argues: "The copying of other media may or may not have impacts similar to those found for photocopying. Only case-by-case empirical investigations of institutions and markets can discover the impacts of these other forms of copying." (Liebowitz 1985, p. 956; as cited in Watt 2005, p. 1). As such, Johnson and Waldman (2005) give examples of markets in which the concept of indirect appropriability is probably not applicable.

means of price discrimination. Price discrimination is possible (and profitable) whenever suppliers can ask for different prices from different types of consumers. However, only if different groups of consumers can be distinguished according to their varying willingness to pay for a single product (Liebowitz 1985; Watt 2005, p. 1).[103] In this regard, journal publishers typically apply a dual pricing strategy as they distinguish between two sub-markets—institutional and individual subscribers. As the elasticity of demand varies significantly between the two markets, price discrimination[104] is feasible and profitable for journal publishers, where institutional subscription prices are significantly higher than those for individual subscriptions (Joyce and Merz 1985, p. 274; Rosenbaum and Ye 1997, p. 1611). This is for at least two reasons: First, the fraction of the budget spent for journal subscription is much higher for an individual. Second, the hypothesis of an inelastic demand for libraries is supported by a tendency of libraries to be complete rather than selective, while individuals may revert to the sharing or renting option as a close substitute (Joyce 1990, p. 1127). In addition, and this is the point Liebowitz (1985) made, the copying option of single journal articles may induce an increase in the value a library assesses to a journal and hence creates an argument for a higher pricing scheme for institutional subscribers.[105] Furthermore, also tying and bundling strategies abound as common pricing schemes in the academic journal market. Here, major publishers offer bundles of different journals to libraries, bundling across journals and also across print and electronic versions (Edlin and Rubinfeld 2005, p. 441). In this regard, a membership to the American Economic Association (AEA), for example, includes a subscription to a bundle of seven journals, e.g. *The American Economic Review*. Furthermore, the annual subscription fee for the bundle of journals is $420 for only print subscription, $840 for print subscription and an electronic site license and $665 for only electronic site license, respectively (Mueller-Langer and Watt 2010, p. 54). The advent of digital copying eventually even created a "better" fundament for such price discriminating practices.[106] All

[103]For illustrating his point, Liebowitz (1985) uses a simple analogy, referring to the automobile company "Ford" that sells cars to both private individuals and automobile rental companies (e.g. Hertz, Sixt etc.). He shows that by accounting for the resale value of used cars (or authorized copies) when they purchase them, Ford (or the copyright owner) can indirectly profit from later uses of their sold cars (or unauthorized copying).

[104]Following a classification by Pigou (1920), economists typically distinguish between three types of price discrimination: (1) first-degree or perfect price discrimination, (2) second-degree price discrimination or non-linear pricing and (3) third-degree price discrimination. As such, dual pricing falls under the headline of third-degree price discrimination as the supplier chooses a pricing scheme in accordance to the Amoroso-Robinson relation. See Robinson (1932).

[105]Phillips and Phillips (2002) note that individuals will treat a single journal as a private good in economic terms, while the journal will take on attributes of a public good for institutional subscribers who will make the journal available to a pool of users.

[106]This builds the bridge to the serials crisis that was outlined in our introduction and hence stresses one of the reasons for rethinking the general institutional structure of the academic journal publishing market. On price discrimination in the digital economy see Fudenberg and Villas-Boas (2012). On bundling strategies for information goods see Choi (2012).

of this reveals that copying may not have a detrimental effect on publishers, since indirect appropriability by means of price discrimination as well as exposure and network effects may eventually create a baseline to indirectly appropriate revenues from unauthorized copying activities.

In 2000 the concept of indirect appropriability was revived by Hal Varian, who applied the concept to the environmental conditions in the presence of digital copying (Towse et al. 2008, p. 10). By analyzing the market for informations goods—including not only journals but also books, computer software, music and videos—Varian (2000) identifies three general circumstances where the opportunities for sharing may increase the profits of a content producer: (1) when the marginal cost of producing a piece of work are above the transaction costs of sharing, (2) when in a situation of low transaction costs of sharing the work is rarely used, and (3) when the producer can identify different types of consumers (high versus low value users) to segment the sharing market. By modelling the different cases identified by Besen (1986), Varian (2005) analyzes the impact of digital technology copying on the price setting for a content supplier (Towse et al. 2008, p. 10). More recent papers have analyzed the relationship between optimal copyright duration and price discriminating practices in a digital environment. As such, Meurer (2001) and Gordon (1998) analyze the effect of copyright law on the ability of suppliers of copyrighted works to price discriminate. Yuan (2010) studies the opposite case, simulating the optimal copyright duration subject to price discrimination.

As a consequence, the broad discussion on the relationship between copyright law (plus alternative mechanisms) and new developments of copying technologies already reveals the importance of research to understand the interdependencies of various different issues. Nevertheless, recent reforms in copyright law still rather suggest that an extension of copyright law is required to motivate authors to be creative in an environment of digital copying. These developments and the reactions by academia shall be discussed in the following subsection.

2.1.3 Copyright in Transition: Challenges in the Information Age

Copyright and Technological Change

Obviously, it is the development of new technologies for the production, copying and distribution of copyrightable works that has been driving major changes, especially in the last quarter of the history of copyright law. The series of reforms—starting with the "WIPO Copyright Treaty" and the "WIPO Performance and Phonogram Treaty" in 1996 that were implemented into national legislation shortly after—have decisively extended the rights of the owners of copyrightable works. All efforts said to adapt copyright law to the challenges of an environment that is characterized by digital media technologies. In particular, with the Digital Millennium Copyright Act (DMCA) in the US and the EU Copyright Directive

of 2001 a new section was added to copyright that specifically addresses the use of Digital Rights Management (DRM) technologies, i.e. a class of access control technologies that may be used by sellers of digital content or devices to effectively control the access, use and distribution of digital content (e.g. sound recordings, movies etc.). As such, the DMCA[107] adds a new chapter 12 to title 17 of the US Code, clarifying that (any)[108] circumvention of technological measures is prohibited by the law and criminalizes the production and dissemination of technologies whose primary function aims at circumventing technological measures that protect copyrighted content. These developments in the "right to copy" can generally be understood as a reaction towards the new digital environment. As previously outlined, this digital shift induced considerable changes in the cost structure and the quality of copying technologies (Eger and Scheufen 2012a, pp. 169 et seq.).

In academia, these developments have induced a heated controversy regarding the effectiveness and general role of intellectual property rights.[109] In particular, several economists have expressed their rather critical perspective on the attempts to further strengthen copyright law. First and foremost, on 20 May 2002 seventeen leading economists[110] (including five Nobel laureates) presented an amicus curiae brief as a response to the Sonny Bono Copyright Term Extension Act (CTEA), revealing doubt on the reasonability of the 20-year copyright term extension for existing and future works of authorship. Akerlof et al. (2002) stress that it is highly unlikely that the economic benefits from extending copyright under the CTEA outweigh its costs. In particular, the authors argue that the CTEA provides no significant effect for creating new works, while significantly increasing the social cost of the temporary monopoly. In addition, they stress that the copyright term extension increase the cost regarding the production of new creative works that make use of existing materials. Liebowitz and Margolis (2005) respond to the arguments forwarded by Akerlof et al. (2002), highlighting that a more comprehensive analysis of the effects of copyright reforms still require "an examination of empirical magni-

[107] See DMCA (1998) on pages 3 et seq.

[108] Generally the new chapter of the DMCA (1998) "divides technological measures into two categories: measure that prevent unauthorized access to a copyrighted work and measures that prevent unauthorized copying of a copyrighted work." (DMCA 1998, pp. 3 et seq.) Accordingly, only the circumvention of the first category is generally prohibited, while the second category may be subject under fair use. Furthermore, section 1201 specifies certain saving clauses and exceptions (DMCA 1998, section 1201(a)(1)(B)-(E)).

[109] Note that there have always been critics of a system of intellectual property rights as a means to overcome the market failure associated with information goods. As such, already Plant (1934) questions the need for any type of a legal protection system, pointing to first mover advantages as means of appropriation for the creator. Also Hurt and Schuchman (1966) and Breyer (1970) question the effectiveness of copyright law.

[110] Including *George A. Akerlof, Kenneth J. Arrow, Timothy F. Bresnahan, James M. Buchanan, Ronald H. Coase, Linda R. Cohen, Mitlon Friedman, Jerry R. Green, Robert W. Hahn, Thomas W. Hazlett, Scott Hemphill, Robert E. Litan, Roger G. Noll, Richard Schmalensee, Steven Shavell, Hal R. Varian and Richard J. Zeckhauser*. Henceforth Akerlof et al. (2002).

tudes that no one has fully undertaken." (Liebowitz and Margolis 2005, p. 457).[111] Png and Wang (2009) and Hui and Png (2002) provide empirical evidence for the impact of the extension of the copyright term and the European Rental Directive, finding no statistical robust effect of either reform on the production of new movies. Other critics even advocate the abolition of copyright. Among the strongest advocates of an abolition of copyright law in the information age are Boldrine and Levine (2002)[112] and Lessig (2001).[113] Besides, Ku (2002) suggests—by analyzing the Napster case—that intellectual property may even be counterproductive with respect to digital products. As a consequence, there has been a series of important papers that have been analyzing possible alternatives to a system of copyright law.[114] Especially rewards and prizes as a means of public funding have been discussed as a reasonable alternative for creating incentives for innovative endeavour. In this context, Shavell and van Ypersele (2002) show that a system of intellectual property rights has actually no fundamental social advantage over a reward system. Furthermore, the authors advocate an optimal reward system, i.e. a system where the creator may choose between rewards and intellectual property rights, over a pure IPR regime.

Other scholars, in contrast, have still been advocating a strong copyright protection. Some authors have even raised arguments to support a copyright that virtually lasts forever (Landes and Posner 2002, 2003; Turnbull 1998). In particular, Landes and Posner (2002) argue in favour of an infinitely renewable copyright that would just follow the rationale applied in the system of trademark law.[115] The authors provide with empirical evidence for the fact that for the vast majority of existing works a renewal of the copyright term would eventually not be valuable. This is particularly true for works of low average commercial value. With a short but renewable copyright term these kind of works would enter the public domain at an early stage, minimizing access, transaction and administration costs. Those few works that are of high average commercial value for its right holders would, however, retain their value by remaining in copyright protection forever (Landes

[111] On the need for further empirical research on the impact of copyright law for the supply of creative works see Png (2006) as well as Handke (2010).

[112] See also Boldrine and Levine (2005) and Boldrine and Levine (2008). For a discussion see McManis (2009).

[113] Shavell (2010) very recently raised the question of an removal of copyright law concerning academic works. We will elaborate further on Shavell (2010) in Sect. 2.3. At its heart, this thesis extends on Shavell's work, seeking to give answers to the question whether an abolishment of copyright for academic works is socially desirable.

[114] Varian (2005) gives a short overview on the alternatives to a legal copyright protection. Gallini and Scotchmer (2002) discuss different scenarios where legal mechanisms are not superior to its alternatives. See also Liebowitz and Watt (2006) for a discussion of the alternatives to copyright in the music industry.

[115] A trademark is generally granted for a term of 10 years with the option to indefinitely renew the term. That is, a trademark can virtually last forever. See Besen and Raskind (1991) or Mueller-Langer and Scheufen (2011a) on the economics of trademark law.

and Posner 2002, p. 41). Thus, Walt Disney would have had the chance to retain their rights for Mickey Mouse without affecting all other existing works and especially without any means of rent-seeking. Such a system would, however, be especially valuable with respect to out-of-print and orphan works, i.e. works for which locating the copyright owner has become prohibitive or even impossible. Orphans would enter public domain after expiration of the shorter copyright term as there would be nobody to renew its term. Obviously, an indefinitely renewable copyright could eventually provide with a solution to a still prevalent dilemma that has been repeatedly tried but failed to be solved by the US Congress in the history of copyright legislation (Eger and Scheufen 2012b).[116]

Recent Developments in the Economics of Copyright

Recent developments in the economics of copyright have taken a more critical position regarding the relevance of copyright for creating incentives for creative activities. In this context, Towse (2001) shows that there is eventually no empirical evidence that copyright actually increases the earnings of the creators in the creative industries. Moreover, she emphasizes the inequality in the level of earnings by particularly pointing to two observations: First, due to market power and better opportunities for rent-seeking by publishers we can observe a distortion in the distribution of income for the benefit of the publishers. Second, several examples of industries abound where monetary rewards seem to be rather negligible for stimulating creativity. As such, Towse (2001) shows that only a small minority of superstars generates a considerable income from copyright,[117] while the vast majority of creators can hardly earn their living (Eger and Scheufen 2012a, pp. 171 et seq.).

Obviously, there must be other factors but financial gains that explain why somebody engages in creative activities. In this regard, especially the role of so-called intrinsic motivation or other motivational factors (like reputation or social recognition) has been emphasized to better explain certain behavioural patterns in some creative industries or branches. Most important in creating a new notion of knowledge production has been the emergence of so-called open peer-production models, like the movement of Open Source Software (OSS) or Wikipedia.[118] The

[116]See also Mueller-Langer and Scheufen (2011b) who discuss the orphan works dilemma in the light of the Google Book Search Project.

[117]On the economics of superstars see Rosen (1981).

[118]With the organization model "the bazaar" as opposed to the traditional model of "the cathedral" Raymond (1999) turned the notion of intellectual property on its head. Raymond (1999) argued that the development of a new software should proceed on the basis of an open peer production process ("the bazaar") where everybody can contribute voluntarily by writing a part of the source code. The traditional model, in contrast, favoured an organization in small isolated teams on the basis of secrecy—very much like the organization in the building of a cathedral. Raymond (1999) somehow revolutionized the way of thinking organizational procedures by adding a third model to

general idea of the OSS movement is that large and informal groups of volunteers contribute freely to the development of a software by directly affecting the source code of the software and providing with incremental improvements or solving specific problems, i.e. they provide with certain modules (pieces of code) of the software. Recalling the rationale of a system of intellectual property rights, finally, Lerner and Tirole (2002) frame the revolutionary character of the OSS model by asking: "Why should thousands of top-notch programmers contribute freely to the provision of a public good?" (Lerner and Tirole 2002, p. 198). The literature on the economics of OSS finds three basic arguments for answering this intriguing question. Accordingly, programmers may be motivated by means of (1) simple enjoyment, (2) career concerns and (3) ego gratification (Lerner and Tirole 2002, pp. 212 et seq.; Rossi 2006, pp. 16 et seq.).[119] Accordingly, a programmer may be motivated to add a new algorithm to the source code of a software as she simply enjoys her doing. In particular, the open character of OSS may give her the freedom to choose a project that matches her skills and interests. An aspect that is certainly more difficult to satisfy in the hierarchy of a software company. Lerner and Tirole (2005) emphasize that "a 'cool' open source project might be more fun than a routine task." (Lerner and Tirole 2005, p. 58). Both later aspects—career concerns and ego gratification—may be summarized under the single heading of "signaling incentives" (Lerner and Tirole 2002, p. 214). This signaling may take on two dimensions: On the one hand, a contributor may have the chance to demonstrate her ability in solving specific problems in software engineering and hence may profit from participating by means of better labour market opportunities. On the other hand, a programmer may seek to just be a member in the group of peers and hence seeks a "socialisation" in the community of software experts. The assignment of the term "hacker" may then be understood as a form of honor within the OSS community (Lakhani and Wolf 2005, p. 5; Scheufen 2011, p. 5). As a matter of fact, the "peer-production" model may create a baseline for questioning the role of intellectual property rights (copyright) in stimulating creative endeavour. Nevertheless, in evaluating the role of copyright in a certain market, like the market of science, an understanding of the characteristics and motivational conditions of this particular market is crucial. Consequently, the following section shall introduce to the economics of science and create a fundament to further assess the role of academic copyright as an incentive to do research.[120]

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the traditional models of the market and hierarchy as distinguished by Coase. This "paradox" is also referred to as the Coase's Penguin. Here, the penguin refers to the mascot of Linux as one of the pioneers in the OSS movement. See Benkler (2002).

[119]We will later see that the motivation of a programmer to contribute to the production of an Open Source Software correlates considerably with the motivational structure for a scientist. See Scheufen (2011) on the analogy between open source and open access.

[120]Obviously, this book sees itself in the tradition of this literature stream, questioning the role of copyright law in the market for academic publishing.

2.2 The Economics of Science

2.2.1 The Concept of Science and Scientific Research

Understanding the Nature and Principles in Science

Science—lat. *scientia*, knowledge or information—can generally be described as the process of human activity to develop or generate an accurate knowledge and understanding of nature, regarding the past, the present and the future (Freedman 1960; Coccia 2006, p. 11). The Webster's New Collegiate Dictionary defines science as "systemized knowledge as an object of study" or "knowledge covering general truths or the operation of general laws esp. as obtained and tested through scientific method" (Mish 1985, p. 1051). Obviously, science is far from being a static concept, but is rather a matter of continuous modification of or adaption to new environmental conditions. Furthermore, the development of new scientific methods may eventually revert a current state of knowledge as our perception of the world (a theory) may be falsified.

Conceptionally, the term science needs to be distinguished from the rather closely related terms of "research" and "scientific research". In fact, science and scientific research are frequently being used synonymously (Coccia 2006, pp. 9 et seq.). The term research refers to the general process of gathering information. Freedman (1960) describes research as a continued search for knowledge and understanding. It is to be distinguished from science, as research does not necessarily include scientific information and the application of scientific methods. As a matter of fact, the term research is today rather used to mean anything from surfing the web for good sale offers to reading the daily newspaper. In contrast, scientific research adds "scientific" to the expression as it refers to the continuous process of scientific knowledge accumulation by the application of scientific methods. Research as such is then only the first step to scientific research, as it more generally describes the gathering of data. A person reading a book to receive a better understanding of the world is hence not (yet) engaged in scientific research. Recalling the definition of science in general reveals that scientific research is much broader and can be seen as the combination of both science and research. Figure 2.2 shall summarize the conceptual differences of the terms science, research and scientific research.

Obviously, the application of scientific methods is crucial to go the additional step towards scientific research. In this regard, we can generally distinguish between two approaches or types of methods: the deductive approach and the inductive approach.[121] The deductive approach starts at a more general conception of a certain problem and seeks to deduce a more specific information. As such, a general

[121]This general differentiation can be traced back as far as to Aristotele (384 BC–322 BC) who was among the pioneers to describe the deductive approach in methodology. Among the first to develop the inductive reasoning was Francis Bacon (1561–1626), where Galileo Galilei (1564–1624) later added the mathematical formalisation. See also Coccia (2006) on pages 11 et seq.

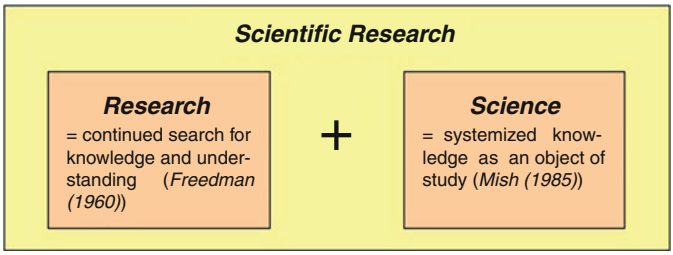

Fig. 2.2 A conceptualization of scientific research

theory states the starting point for deriving hypotheses which are tested against the background of real life observations. The specific information derived from testing our hypotheses is the evidence derived for a falsification or verification, which allows conclusions on the reasonability of the theory being tested. As a consequence, the deductive approach is often referred to as a "top-down" approach. The inductive method, in contrast, follows a "bottom up" approach and hence moves from a specific observation towards a generalization or definition of a theory. As scientific research requires the application of either deductive or inductive reasoning, there are two fields of scientific research that follow the lines of either of the two approaches: basic research and applied research (Godin 2001; Coccia 2006, p. 11). While basic or pure research is conducted solely for the purpose of accumulating and extending on existing knowledge, applied research seeks the resolution of a particular problem. It is important to note that basic research often builds the foundation for applied research, as it provides with a more general understanding of the functioning of the world on which applied researchers can extend on. Notwithstanding the fact that the lines between these two fields can be blurred in some respect, a distinction is reasonable and useful for the purpose of our investigation.

As we seek to understand why scientists do science and whether a certain publishing model matches with the norms and organizational structure in scientific research, it is necessary to clarify the antetype of a scientist that builds the core of our analysis. Most importantly, our analysis will focus on such activities that are not primarily addressed at providing any commercial purpose. That is, we will not be interested in the commercialization of science, like it is often the case for example in the field of biotechnologies. Here patents play an important role to protect one's intellectual assets.[122] Consequently, our analysis will primarily address the field of basic research, where a publication rather than a patent application is the output of research. As already outlined in our introduction, we will focus on academic works to which Peter Suber refers to as royalty-free literature. This has two important implications: First, the publisher receives the work from the authors at no costs.

[122] See e.g. Scotchmer (2011) on the role of patents in university research.

Second, the author should (ceteris paribus) be open to the publishing mode (open or closed access) as she is not losing any revenue (Suber 2012, p. 9). It is this type of literature that we have in mind when analyzing the impact of copyright versus open access for the scholarly system as a whole. Before we move on, however, an understanding of the incentives of authors of this type of literature is important.

The following chapter shall first give an overview of the fields of study in the analysis of scientific research before focussing on the reward structure in science and hence the motivational forces of the researcher that we have in mind.

The Analysis of Scientific Research: Fields of Study

The analysis of scientific research covers several fields of study and as such ranges from economics—including pure economics, managerial economics, political economy and economic history—to sociology and philosophy. In "modern" economics eventually three different fields of study can be distinguished.[123]

First, economists have come to realize the importance of science for the advancement of technologies and hence for economic growth. In fact, modern growth theory emphasizes the role of science and technological innovations for productivity. Especially the works by Romer (1986, 1990) increased the attention to science as the major factor for technological innovations.[124] In particular, economists in this field have analyzed the relationship between science and technology as well as the role of knowledge spill-overs from science for economic growth.[125] Also the role of scientists in the industry has been addressed to understand the scientist's input for creating the capacity of firms in the development of innovations. As such, Cohen and Levinthal (1989) highlight that scientific knowledge is crucial for both

[123]Coccia (2006) follows the structure of Stephan and Audretsch (2000) and distinguishes primarily ten different fields of study in the economics of science, ranging from the public nature of scientific knowledge to the studies of scientific research and economic growth. In particular, see Coccia (2006) on page 11. Nevertheless, all ten fields may be summarized to cover primarily three different fields of study in the analysis of scientific research.

[124]Earlier models in growth theory especially by Solow (1956) and Swan (1956) were only able to explain the impact of technological progress on the long-run rate of growth by means of a "risidual" (Solow risidual) as growth was exogenously determined by new technological developments. Endogenous growth theory in contrast endogenizes technological progress by particularly emphasizing the relevance of so called spill-over effects. On the origins of endogenous growth see Romer (1994).

[125]On the relationship between science and technology see in particular Rosenberg (1974), Scherer (1982) and Gibbons and Johnston (1974). Extending on Romer (1990) especially Griliches (1992), besides Jaffe (1989), Audretsch and Feldman (1996) and Acs et al. (1994) analyzed the importance of knowledge spillovers from science for economic growth. Diamond (2004) provides with an overview on Zvi Grichile's contributions for understanding the economics of technology and growth.

the production of new knowledge and the adoption of external knowledge developed outside of the firm—so-called absorptive capacity.[126]

Second, economists have analyzed the scientific labour market and the human capital embodied in scientists for understanding the labor market conditions in science. Ehrenberg (1992) provides a comprehensive analysis on the main characteristics in the labor market for scientists. By analyzing the determinants that explain the supply and demand in the scientific labor market, Leslie and Oaxaca (1993) review the process of forecasting labor market conditions that help to understand the failure and success of particular research careers.

The third field in the analysis of scientific research addresses the appropriation problem associated with the production of a pure public good. The origins of these studies revert back to the analysis of the nature and the conditions for the production of scientific knowledge. Obviously, the most fundamental characteristic of scientific knowledge is its public good nature. The starting point for analyzing the consequences of the public good nature of scientific knowledge are the seminal works by Samuelson (1954) on the theory of public goods and Arrow (1962) and Stigler (1961) on information economics, laying the foundation for the analysis and consequences coinciding with the provision of public goods. Arrow (1962) particularly emphasizes the consequence of an underprovision of the public good as private and social incentives differ considerably.[127] More recent works by Callon (1994) and Dasgupta and David (1994) provide with a more differentiated picture on the public good problem, highlighting the role of tacit knowledge (Callon 1994) and arguing that scientific knowledge may only satisfy the characteristics of a public good if they are codified in a manner that can be understood by others (Dasgupta and David 1994). Furthermore, several economists have tried to measure scientific contributions, i.e. the added value a certain publication provides for the progress of science,[128] and to explain productivity differences among scientists (Allison and Stewart 1974) or over the life cycle of a scientist's career (Levin and Stephan 1991; Diamond 1986). A matter of particular interest in this field of study is to understand the incentives structure in the market of science. This latter issue is of particular relevance for the purpose of our investigation, as we seek to understand what impact a regime change—from a closed access (copyright) to an open access regime—would have on the incentives of scientists to contribute to the advancement of science. As a consequence, the following section provides a brief review on the

[126] See also Mansfield (1995), Nelson (1962), Rosenberg (1990) and Lichtenberg (1988) on the role of scientists and basic research for industrial innovations.

[127] See Sect. 2.1.2 for a review of Arrow's argument and the consequences for a justification of copyright law.

[128] A prevailing method for measuring the impact of a certain publication to the advancement of science is to revert back to citation counts. Nowadays individual contributions are being evaluated by the Social Science Citation Index of Thomson Reuters. See Lindsey (1989) on the use of citation counts for measuring scientific output. See also Garfield (1955) on the foundations. A literature review on bibliometric measures of productivity is provided by Diamond (2000).

general insights gained from the economics of science for understanding the motives of scientists by particularly addressing the reward structure of scientific research.

2.2.2 The Reward Structure of Science

Some General Insights

Since our analysis shall later reflect more carefully on the norms, incentives and organizational structure in the market of science, we will first need to understand more about the mechanisms or primarily about the rewards that explain motivational patterns in this market. This section shall provide an understanding of the motives of a scientist to contribute to the advancement of science and hence seeks to answer a compelling question: Why do scientists do science?

In this regard, we may learn from the literature in psychology which generally distinguishes between two types of motivation that drive individual behaviour: intrinsic and extrinsic motivation.[129] While intrinsic motivation refers to an action that is driven by an inherent satisfaction or simple enjoyment, extrinsic motivation explains any action by means of attaining a certain outcome or reward. As a result, an individual that is intrinsically motivated may engage in a certain activity due to the "fun factor" or the challenge she assigns to her doing. Thus, it is rather the inherent interest in a certain activity than the external prods, rewards or pressure that may explain certain decisions in human behavior (Ryan and Deci 2000, p. 56). As a simple example we may assume that the reader of this section is curious of getting to know about a scientist's motives. In contrast, any performance that can be summarized as being extrinsically motivated is done to attain some separable outcome (Ryan and Deci 2000, p. 60). In fact, Ryan and Deci (2000) emphasize that eventually the vast majority of all human activities is driven by extrinsic motivation. The authors stress that after the early childhood "the freedom to be intrinsically motivated becomes increasingly curtailed by social demands and roles that require individuals to assume responsibility for nonintrinsically interesting tasks." (Ryan and Deci 2000, p. 60). Experimental studies eventually show that the relevance of extrinsic motivation increases with each advancing grade in school.[130] The nature of the rewards that trigger such behaviors may be direct (money, prizes) or indirect (CV-effects, future income). Recalling the earlier example of our reader, an extrinsic motivation to continue with the reading of this section may be to learn new skills because he or she understands the potential value or utility of these skills for

[129] On the theory of motivation in general see Cofer and Apply (1967). For an analysis of extrinsic and intrinsic motivation and their interdependencies in human behavior see Deci et al. (1999) and Deci and Ryan (1985).

[130] See the literature cited in Ryan and Deci (2000).

generating present or future net income, e.g. by an application of these insights to his or her own research or in case of a student to achieve a good grade in her exams.

We apply this more general framework for assessing a typology on the rewards that drive the motivation pattern of a scientist. Thus, we will first look at possible extrinsic motives for doing science before turning to other explanatory factors beyond (monetary) rewards that may be rather explained by intrinsic motivation. After all, a typology of the rewards will summarize the different motives in science and highlight the relationship between and relevance of the intrinsic and extrinsic rationale for the decision to engage in scientific research.

Priority to Discovery: The "Ribbon" and the "Gold"

At the core of any scientist's endeavour to "do science" is primarily the goal to establish priority to discovery (Merton 1957, 1973). In this context, particularly two "motivational fields" can be distinguished: (1) peer-recognition ("the ribbon") and (2) monetary rewards ("the gold").[131] We will see that the boundaries between both types of motives are somewhat blurred and to a large extend build on each other. Accordingly, the rewards scientists may gain from being first to communicate a discovery is the recognition that is assigned to the researcher by her peer group. In its core is the pursuit to accumulate reputation in the eyes of her peers (Stephan and Levin 1992, p. 18). The reputation capital accumulated over a scientific career, finally, seeks two particular purposes.

On the one hand, it may serve the simple means of ego gratification in the sense of a community-based intrinsic motivation.[132] Here, several forms of recognition can be distinguished. First and foremost, priority to discovery allows for the attachment of the scientist's name to her discovery and hence leads to the reward of eponymy. In fact, in practice several examples of eponymy abound, such as the Gaussian Curve (Carl Friedrich Gauss, 1777–1855), the Pasteurization (*Louis Pasteur*, 1822–1895) or the Otto engine (*Nicolaus August Otto*, 1832–1891). In economics, the Nash-Equilibrium (*John Forbes Nash Jr.*, 1928–) or the Pareto-Criterion (*Vilfredo Federico Pareto*, 1848–1923) state famous examples for the association of the founder with his or her discovery. Second, prizes and awards state a special form of reward which seek to recognize the role of particular scientists for the advancement in certain disciplines.[133] Zuckerman (1992) estimates more than 3,000 different

[131]The notion of "the ribbon" and "the gold" follows from Stephan and Levin (1992) and Stephan and Everhart (1998).

[132]Following Lindenberg (2001), intrinsic motivation can be distinguished in enjoyment-based and community-based intrinsic motivation. We will elaborate on the first one in the next section.

[133]An award or prize may have different levels of properties. Besides social prestige and recognition, Frey and Neckermann (2009) also highlight that (1) winning an award generally provides its recipient with a "warm glow" or good feeling, (2) awards are conferred by principals whose opinion the agent values and (3) awards provide with monetary compensation or other material benefits. In addition, it is the enjoyment derived from being in competition with other

prizes in the early 1990s in North America alone. Among the variety of different prizes, the Nobel Prize[134] provides the most prestige to its laureates. In mathematics, for instance, the so-called Fields Medal for mathematicians not older than 40 and the Wolf Prize provide with a similar prestige. Third, a scientist may be rewarded by means of titles and fellowships. As such, the achievements of one's contributions may be honored by the degree of a *doctor honoris causa* (honorary doctorate). Or a scientist may be elected to national or international academic societies—e.g. the Royal Society, the European Academy of Sciences and the Bavarian Academy of Sciences—as a particular form of recognition. Also invitations to keynotes, board memberships and editorial positions at prestigious journals are important aspects.

On the other hand, the reputational capital accumulated over time also acts in pursuance with career concerns. That is, scientists are interested in an impressive curriculum vitae to signal one's status within the scientific community and to receive appointments for professorships at prestigious departments or to be considered for consulting. A necessary premise for establishing priority and hence to gain recognition is by signaling one's contributions and hence skills on the basis of (high quality) publications.[135] A frequently applied output measurement for assessing and operationalizing a scientist's output is the so-called Social Science Citation Index (SSCI) by Thomson Reuters.[136] Accordingly, it is not the number of publications but the number of citations assigned to the papers of an individual researcher that counts for indirect benefits which accrue through CV-effects. In the end, this instrument finally helps to distinguish between different types of researchers (good or bad type/high or low quality) and provides the researcher with the opportunity to signal her skills for future job opportunities.

However, the behavioural patterns of our researcher may not only be intrinsically motivated. In particular, the reputational capital or the "reputation-building-claims" (Dasgupta and David 1994, p. 498) accumulated by different means may as well

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peers that may provide the participant with pleasure irrespective of outcome (Frey and Neckermann 2009, pp. 76 et seq.).

[134]The Nobel Prize is each year awarded for achievements in physics, chemistry, medicine or physiology, literature and peace. Since 1969 the "Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel" extended the scope of Nobel Prizes with respect to the economic discipline. Each laureate receives a Nobel Prize diploma, a Nobel Prize medal and is endowed with the prize money. Since 2001 the prize is set at (SEK) 10 million per full Nobel Prize. The announcement of the laureates is each year in October. The awards ceremony is held in Stockholm and Oslo (only the Nobel Peace Prize) each year within the week of December 10, which is the day when Alfred Nobel died in 1896. See http://www.nobelprize.org (last accessed on September 1, 2014) for more information.

[135]Stephan (1996) highlights that while eponymy or the Nobel Prize is most often beyond the reach for the majority of researchers, recognition by means of publications or citations is in reach for almost every scientist.

[136]The SSCI generally provides with bibliographic and citation information to find research data and to analyze trends, journals and individual researchers. In present (September 2014) the SSCI lists 3,000 of the world's leading social science journals and covers 50 disciplines. See http://scientific.thomsonreuters.com/products/ssci (last accessed on September 1, 2014).

be expressed in monetary terms, since the payment schedule in science allows for material rewards like a higher salary or access to research facilities subject to a scientist's reputational standing. In this regard, the nature of science as a "winner-takes-it-all" contest positively defines a payment schedule that consists of two components. First, a fixed flat[137] salary as a compensation for the risk of not being the winner of the "priority game" and hence as an incentive to actually enter the game. Second, a reward to the winner of the scientific competition in terms of a bonus that is granted subject to the scientist's reputational status. Most important is to understand that the most productive scientists may enjoy substantial salary premiums as a good performance makes the scientist attractive for other institutions (Stephan and Levin 1992, p. 21). That is, salary is at least indirectly related to productivity as more productive scientists are more likely promoted. Nevertheless, there is also evidence for "pay-for-performance" models that are applied at some universities. An extreme example of such a model is the Vienna University of Economics and Business Administration, where faculty members receive a reward payment of 1,000 € for a publication in an "A journal" and 3,000 € for a publication in an "A+ journal" (Frey and Neckermann 2008, p. 2). Even though these "pay-for-performance" models are applied in a far less rigid way at most universities, more successful researchers may still be able to increase their salary by means of bargaining or by receiving outside research funding.[138] Moreover, Stephan and Everhart (1998) emphasize the opportunity to act as consultant[139] for private enterprises or as an employed researcher in the industry.[140] As a consequence, every publication and more importantly citations support the scientist in increasing his own market value—not only in reputational but also in financial terms.[141] Last but not least, also prizes or awards generally provide its recipients with material rewards. As such, the Nobel Prize is endowed with a monetary reward of (SEK) 10 million (i.e. approx. 1.1 million Euros) per full Nobel Prize.

[137] Dasgupta and David (1987) argue that a discovery that is made a second or third time does not add any value to the social surplus resulting from its first discovery (Stephan 1996, p. 1202). Thus, only a flat salary as an "entrance royalty" allows for an efficient allocation of resources, as only this payment schedule helps in bearing the risks of being a loser in the "priority game".

[138] See e.g. Frey and Neckermann (2008) on the various (monetary) rewards in academia.

[139] A famous example in the economics discipline is *Hal Ronald Varian* who was professor of microeconomics at the University of California at Berkeley before he joined Google Inc. as a consultant in 2002.

[140] Of course, the job market opportunities for scientists are much broader and an analysis is in need for a deep understanding about the conditions in the scientific labour markets. As this is beyond the scope of this work, we would like to point to some literature for further reading. Especially the works by *George Stigler* are important to recognize. See Diamond (2005) for an overview on Stigler's contributions. A general overview on the (labour) market for scientists is given by Stephan (1996) on pages 1211 et seq.

[141] In this respect, Diamond (1986) estimates that the net present value of a 35-year old scientist (in 1994 dollars) ranges from $2,225 (for a physicist) to $6,750 (for a mathematician).

Intellectual Satisfaction: Solving the Puzzle

Nevertheless, science is obviously more than just money and prestige. The sociologist Warren Hagstrom explains that "research is in many ways a kind of game, a puzzle solving operation in which the solution of the puzzle is its own reward" (Hagstrom 1965, p. 16; also cited in Stephan and Levin 1992, p. 18). As such, a scientist may have an inherent interest in doing scientific research that may best be explained by intellectual satisfaction. Just like pure intrinsic motivation is mostly a phenomenon observed in childhood, a scientist may be somehow special as her interest is purely driven by the excitement of being at the forefront of a particular research field. In this regard, Hull (1988) understands science as "play behavior carried to adulthood" (Hull 1988, p. 306). Most important is to highlight a form of enjoyment-based intrinsic motivation that drives the decision to contribute in a certain field of interest (Stephan and Levin 1992, p. 18).

In this context, Csikszentmihalyi (1974)—as one of the pioneers in studying the dimension of enjoyment—highlights the importance of reaching a so-called "state of flow" that maximizes the enjoyment derived from solving a particular problem or puzzle.[142] A state of flow is reached if the skills of a particular person are matched to the challenges of a task. A matter of particular relevance to ensure such a matching is the concept of academic freedom, as it provides the scientist with the freedom to choose the optimal zone of activity in which her state of flow is maximized. Thus, puzzling at the forefront of an exciting research field may then provide with positive net benefits or an additional satisfaction far from monetary terms (Scheufen 2011, pp. 3 et seq.).

The Rewards in Science: A Typology

All of the aforementioned aspects greatly reveal the complexity of the mechanisms in and organization of scientific research. The immanent rules to foster scientific progress and to implement measurements for a selection process in the "scientists game" show that our researcher's motivation is far from being monocausal. In fact, several motivational factors may explain behavioral patterns of researchers in the market of science. Figure 2.3 gives an overview on the main motivational factors (dark grey) and the various rewards (light grey) in science.

In conclusion, a typology on the reward structure reveals three aspects to play an important role regarding the incentives structure in science. First and foremost, the recognition ("the ribbon") awarded to priority and hence the gained scholarly esteem from being first to acknowledge a certain issue. In this context, scientists

[142]This goes in line with the above mentioned typology provided by Lindenberg (2001) who distinguishes between enjoyment-based and community-based intrinsic motivation. See also Lakhani and Wolf (2005) on pages 4 et seq. On this basis, Scheufen (2011) looks at the parallels in the motivation of scientists and software engineers/ programmers.

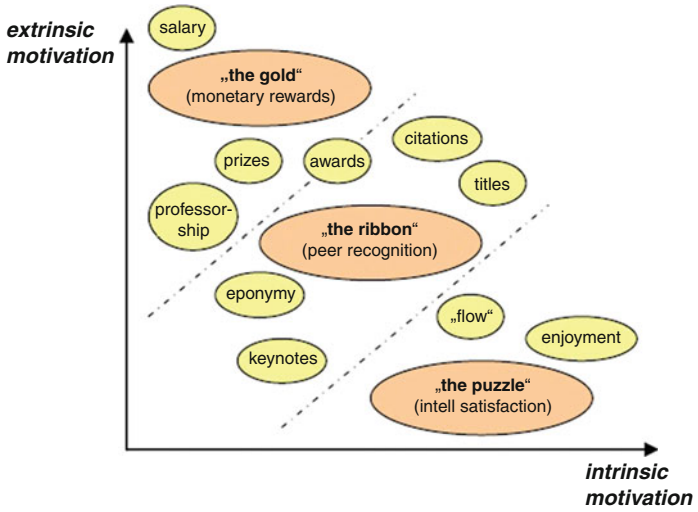

Fig. 2.3 The reward structure in science: a typology

seek to accumulate individual reputation to gain both peer-recognition (community-based intrinsic motivation) and future job opportunities by means of a performance signaling. Second, the monetary rewards ("the gold") gained in terms of salary bonuses or prize money also reveal extrinsic motivational forces that explain certain behavioural patterns in the scientific labour market. Third, the pure enjoyment or intellectual satisfaction from solving a puzzle or being at the forefront of the "scientific game" are important to note as a pure (enjoyment-based) intrinsic motivational force.

2.2.3 Some Implications: Why do Scientists do Science?

All of the above shows that the truth of why scientists do science is somewhere in the middle. It is neither the money, nor the pure satisfaction or altruistic motives that drive a researcher to write and publish academic works. Scholars write scientific papers because advances in the knowledge within their field advances their careers (Suber 2012, p. xx). Thus, a scholar writes for the impact, not for a direct monetary reward. What is important for the researcher is the reputation and hence the value a journal publication adds to her bibliography. An analysis of the effectiveness of alternative publishing models will have to take these fundamental insights into account. An optimal publishing regime should hence solve a fundamental trade-off: On the one hand, scholars should receive credit for their writings according to their impact for the advancement of science. The performance of a scientist is measured by the sum of academic works weighed with their impact, i.e. the

reputation/ impact factor that is assigned to a particular journal. The environment for individual career advancement is competitive. On the other hand, new findings should be made available immediately and at minimal costs to (1) enable for priority to discovery and (2) maximize knowledge diffusion.

2.3 A Comparison: The Shavell Model and Beyond

In comparing the economic rationale of copyright with the insights from an economic analysis of the reward structure in science, a discrepancy with respect to both mechanisms seems already at hand. While the public good nature of knowledge or information induces a fundamental market failure with respect to rewards that are market based, in science a non-market reward mechanism has evolved, providing incentives for scientists to behave in socially responsible ways (Stephan 1996, p. 1201). In particular, we have seen that copyright seeks to award the creator of a work with a means of appropriating financial returns as an incentive for creative endeavour. In science, however, these monetary rewards seem to be rather negligible as scientists typically earn hardly any royalties from publishing their research results. In science the authors are rather indirectly rewarded as an impressive publication list or citation rate induces "reputation building claims" for future career concerns. As a matter of fact, with reputation rather than royalties stating the relevant currency in the market of science it may be asked whether copyright for academic works is at all reasonable.

This intriguing question, however, has only recently aroused interest in academia. The development of new technologies to produce, copy and distribute academic works in a more and more digital environment has courted resentment in academia with respect to the rights and duties of academic publishers. While copyright seemed reasonable in the past as a lever for the emergence of (commercial) publishers, recent price discriminating practices by commercial publishers may have already become too expensive to bear (Litman 2006, p. 104). Only with the digital revolution ushered in by the internet publishers gained new price discriminating strategies, such as bundling and versioning options with different print and online choices. As already outlined in the introduction,[143] this development lead to an increase of serial expenditures (serial unit costs) by 273 % (more than 188 %) from 1986 to 2004 (Ramello 2010). As a consequence of this so-called serial crisis, finally, significant cuttings of (university) library subscription portfolios has induced critique in academia. At the same time, however, the advent of the internet gave also birth to a new publishing mode and movement—the Open Access movement—which revived a discussion between publishers, scientific associations and scientists as to whether

[143] See Chap. 1.

the traditional copyright/closed access or the open access model may fit better to the norms, incentives and organizational structure in the market of science.[144]

Despite a lively public debate for now more than a decade, a first comprehensive economic analysis on the effectiveness of both regimes was not done until very recently.[145] In December 2009, Steven Shavell published a working paper analyzing the reasonability of a possible shift towards an OA regime in publishing academic works.[146] In a nutshell, Shavell's arguments can be summarized as follows: (1) scientists seek to accumulate reputation which is increasing in readership, (2) readership is higher under open access and hence scholarly esteem, (3) the publication costs due to a shift towards the "author-pays" principle under open access will be covered by most universities, and (4) there are several reasons why a shift towards an open access publishing model will not be smooth without legislative steps (Shavell 2010; Eger and Scheufen 2012b, p. 55). In July 2010, the Society of Economic Research on Copyright Issues (SERCI)[147] published a special issue as a response to Shavell's primer, putting some of Shavell's conclusions up for discussion. In this context, Ramello (2010) provides with an empirical insight to the market structure of the academic publishing market. Obviously, the academic publishing market has exhibited a trend towards a high market concentration, where only a handful of large journal publishers (especially Elsevier, Springer and Wiley Blackwell) have substantial market power. The previously discussed serial crisis may also be seen as a consequence of this development.[148] Furthermore, Mueller-Langer and Watt (2010) re-consider some of Shavell's modelling assumptions which may significantly change the perspective on the conclusions made from the Shavell model. First, the authors discuss Shavell's assumption that scholarly esteem can be proxied by the simple means of readership alone. This would be true if reputation as a function of readership would be strictly increasing for all values of readership (Mueller-Langer and Watt 2010, p. 46). However, a simple consideration may cause doubt on this belief as it is not the readership but the reputation or ranking of the target journal that matters. An author would more likely submit to a well-esteemed journal with a small number of readers than to a low-esteemed journal with a higher audience. Mueller-Langer and Watt (2010) conclude that it is important to analyze the impact of quality-adjusted readership on scholarly esteem. Extending on McCabe and Snyder (2005) they also raise the question whether copyright may be important to establish a certain level of reputation for a journal in the first

[144] We will further elaborate on the characteristics and evolution of the Open Access movement in Chap. 3. For a general overview on most recently discussed issues see Eger and Scheufen (2012b).

[145] Before the topic had been of interest especially among lawyers. See e.g. the works of Reto Hilty (2006a,b, 2007) as well as Hansen (2005) and Gienas (2008). See Mueller-Langer and Scheufen (2013) for a broad literature review.

[146] The paper was later published in the Journal of Legal Analysis. Henceforth Shavell (2010).

[147] See http://www.serci.org/ (last accessed on September 1, 2014).

[148] We will further elaborate on the market conditions in the market for academic publishing in Sect. 3.1.

place. Taking both consideration into account, Mueller-Langer and Watt (2010) are more sceptical regarding a shift towards a universal open access regime in academic publishing. Second, they argue that an abolishment of copyright may be particularly detrimental for top institutions (like Harvard etc.) with a relatively high publication output since the total publication fees (open access regime) may more than outweigh the savings in total subscription fees (CA regime). Looking at eight top-tier journals in economics and 517 institutions they suggest that publication fees under open access would "punish" any institution above a certain level of research output. As a result, the authors propose a modification of the open access regime which may provide for the best of both the copyright and the open access regimes (Eger and Scheufen 2012b, pp. 55 et seq.). In addition, Watt (2010) emphasizes that an analysis of the possible impact of an elimination of copyright for academic works will have to take into account both the total quantity of publications but also the average quality of the works. In this regard, McCabe and Snyder (2004, 2005) provide with a simple (two-sided market) model to provide evidence for a possible quality degradation of journal content. The authors argue that if journal publishers charge a fee per publication, this is likely to result in a situation of accepting papers that would otherwise not have been accepted. As such, a publisher will have the incentive to accept additional papers to internalize the fees paid by the authors. Obviously, each publisher would accept additional papers as long as the marginal benefits would outweigh its costs. As a result, the set of accepted papers would likely increase and hence cause a degradation of the minimum quality threshold for paper acceptance.[149]

Despite the increasing interest in the topic and a flood of various papers analyzing the effects of an abolishment of copyright for academic works ever since Shavell (2010), several questions still remain unresolved. Most importantly, it is still questionable whether online access to journal content has created an environment that supports the demand of scientists for reputation or higher citation counts.[150] In fact, there is still very little and even contradicting empirical findings for these important questions. In this regard, Lawrence and Giles (2000) provide with evidence for a three times higher citation rate on average for open access content. Besides, Eysenbach (2006) applies a longitudinal bibliometric analysis of a cohort of open access and non open access articles, analyzing "The Proceedings of the National Academy of Science" (PNAS).[151] He highlights that open access articles are more immediately recognized and cited by a factor of two. Also Norris

[149]Similarly Jeon and Rochet (2010) stress that open access induces profit maximizing publishers to set socially inefficiently low quality standards. Also in a two-sided market model, Mueller-Langer and Watt (2012) identify countervailing effects and conclude that also high-quality journals may provide open access.

[150]No doubt, access to academic works via the internet has significantly changed the way scientists search and use journal content with important implications for the productivity of both research and economic development (McCabe 2011, pp. 21 et seq.).

[151]See http://www.pnas.org/ (last accessed on September 1, 2014).

et al. (2008) find significantly higher citation rates for OA articles, investigating journals in four different disciplines—ecology, applied mathematics, sociology and economics. Similar findings are reported by Hajjem and Gingras (2005) for ten different disciplines, where the advantage of OA ranges between 25 and 250 % by discipline and year. Bernius and Hanauske (2009) extend the scope by investigating the impact of OA on the reputation of scientists in their peer-group, and show that researchers gain in reputation when shifting to the OA mode. In a similar vein, Bernius (2010) reports significant cost advantages of OA. Moreover, he stresses that OA would accelerate the creation and dissemination of scientific knowledge.[152] There are, however, also a few sceptical studies on the readership and citation advantage of open access. Davis (2009) estimates that the citation advantage of open access journals is eventually declining by about 7 % per year and is only 17 % taken all journals together. In contrast, there are also empirical investigations that doubt any citation advantage of open access journals. In this context, Davis et al. (2008) show that open access articles reveal indeed significantly higher download numbers, but with respect to the number of citations there is no such difference between open access and non open access articles. Davis (2011) finds that not the research community may benefit from open access to scientific literature but communities of practice that consume but rarely contribute to the journal content.[153] McCabe and Snyder (2011) confirm the impression of no significant impact of online access on the number of citations. Using panel data on citations to economics and business journals and controlling for article quality by adding fixed effects, they show that JSTOR may help to boost citations by only 10 % whereas ScienceDirect has no effect at all. Nevertheless, in the light of many prevailing methodological weaknesses, such as the problem of selection bias (Bosch 2009), there is room for further and more comprehensive empirical investigations.

Finally, a last branch of literature has been investigating researchers attitudes towards OA publishing. Bernius et al. (2009) consider all stakeholders (scholars, publishers, libraries and funding organizations) and identify reasons why authors may still prefer the "closed access" mode over OA publishing. Imagining a world of two coexisting regimes (closed and open access), the literature emphasizes that researchers may be locked-in to an inefficient Nash Equilibrium (closed access) due

[152] In a study for the Joint Information Systems Committee in the UK, Houghton and Oppenheim (2010) argue that, in the long run, both OA journals and self-archiving platforms will show positive net benefits.

[153] Interesting in this regard is the potential role of free online access for advances in the standard of living in developing countries. For example, access to biomedical and health literature may allow doctors in those countries to improve important health standards. In this context, the "Research4Life" programme has been launched to provide free or reduced fee access to the literature in agriculture (AGORA), health (HINARI), environmental science (OARE) as well as development and innovation (ARDI). We will assess the potential role of this programme in Sect. 4.2.2.

to the reputation advantage of established closed access journals.[154] Accordingly, a survey analyzing 481 scientists from different disciplines shows that researchers tend to exhibit a "wait and see" attitude toward OA publishing (Mann et al. 2008). Eger et al. (2013, 2014) highlight that this "wait and see" attitude may differ considerably between disciplines and countries, not only depending on aspects that find their origin in the publishing culture but also policy issues that are more or less successful in promoting gold or green OA.

All of the above shows a great avenue for further research—ranging from theoretical approaches for assessing social welfare implications of copyright versus open access in academia to empirical investigations accounting for the effect of online and free online access to the academic literature.[155] Before approaching some of these intriguing questions, however, we will first look at the scientific journal market and the open access movement in science to understand important characteristics and mechanisms that lay the foundations for our analysis.

[154]We will further elaborate on the reputation advantage of closed access journals in Chap. 3 by analyzing the impact factor distribution of closed access versus open access venues in different academic disciplines. See also the discussion in Chap. 5.

[155]Feess and Scheufen (2013) identify three different lines of research in the OA debate: (i) studies on the economic impacts of alternative publishing models, (ii) studies assessing the effects of open access on readership and citations, and (iii) studies investigating researchers' attitude and behavior towards open access.

Chapter 3
Academic Journal Publishing and the Open Access Movement

3.1 The Academic Journal Publishing Market

In this section we elaborate on the general structure of the academic publishing market. In fact, it is important to understand how the academic publishing market and especially the journal publishing market has evolved over time. First, we will generally look at the principles of academic publishing, creating a basic understanding on the different models for scholarly publication and the players involved. Second, we will elaborate on the specific market characteristics. Facts and figures on the publishing model provide with a comprehensive overview on the immanent structure and changes of market characteristics in historical reflection. The implications drawn from this industry analysis lay the foundations when later reflecting on the effects of certain legislative or policy changes.

3.1.1 The Principles of Academic Publishing

Academic Publishing Models: An Overview

In general, three ways of distributing academic works may be distinguished: (1) Closed Access Journals, (2) Open Access Journals and (3) Self-Archiving or Repositories (Fig. 3.1).

First, closed access journals generally revert to the basic principles in academic journal publishing. That is, the publishing process involves a peer-review for quality selection, but also other services like typesetting and editing tasks. In general, "closed access" means that some form of restriction on the access and use of the journal content is imposed on readers. Publishers provide access to their journals subject to the payment of an individual or institutional subscription price. In the digital era the supply of so-called "Big Deals" has become common practice in

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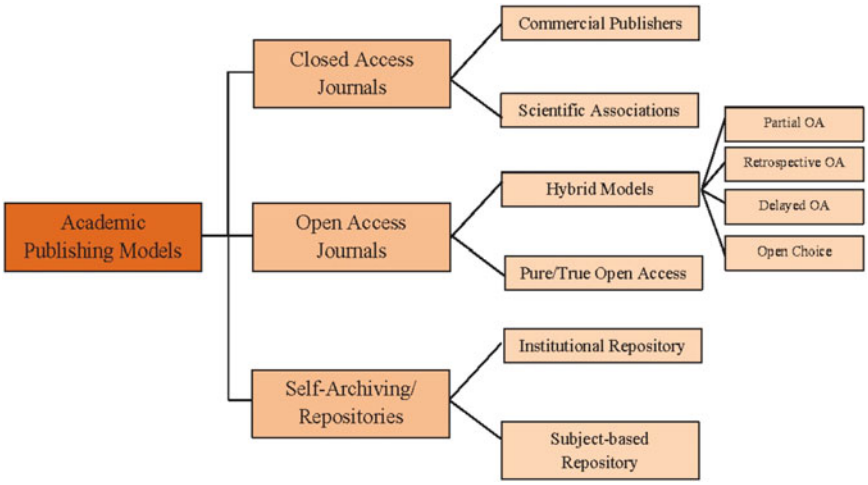

Fig. 3.1 Business models in academic publishing: an overview

the academic journal market, i.e. institutional subscribers (e.g. university libraries) subscribe to online aggregations of multiple journal titles through consortial or site licensing agreements (Houghton and Oppenheim 2010, p. 42). Journals are run by both commercial publishers as well as scientific associations. Second, open access journals revert to the same general principles of journal publishing. That is, the nature of academic publishing remains the same as a peer-review process shall guarantee a minimum quality and other publishing services are provided. In contrast, "open access" means that access to the journal content is not subject to individual or institutional subscription, but is provided free of charge to readers. The publishing costs are typically born by the author (author fee) or funding agencies. In particular, two forms of OA journals can be distinguished: (a) hybrid models and (b) pure or true OA models. While the latter follows the OA principles outlined in the Budapest Open Access Initiative (2002),[1] hybrid OA does not fully satisfy the conditions laid down in the 2002 report. Several hybrid models exist where journal publishers provide with OA to only parts of their set of journals (including only particular works or snippets of a paper), or only in retrospective as well as with a delay of 6, 12 or even 24 months after the publishing date (Bernius et al. 2009, p. 106). A very frequently applied method is Open Choice. With Open Choice authors can make their articles freely available in a separate OA issue upon payment of an author fee.[2] Third, the emergence of the internet has

[1] We will further elaborate on the principles and the development of OA in Sect. 3.2.

[2] Important to note is that all of these hybrid OA models only partially fulfill the principles of OA publishing. In fact, some of these types have been highlighted as being controversial in social welfare terms. Mueller-Langer and Watt (2013) point to countervailing strategies like "double dipping" that have been adopted in Open Choice publishing models. Thus, hybrid OA may at

provided with an additional business model for disseminating academic works—self-archiving or repositories. In contrast to journal publishing, self-archiving does not involve any peer-review or other services generally associated with the publishing process. Instead authors are enabled to deposit their works on internet platforms (repositories), where they can make their works available to anyone with internet access and free of any subscription and/or author fee. The requirements for article quality typically revert to a simple academic character threshold, i.e. the paper has to exhibit scientific attributes. As a result, self-archiving can primarily be seen as a platform for disseminating pre-print versions of recent papers and hence as an additional opportunity for communication and discussion.[3]

Academic Journal Publishing

The traditional journal publishing model involves basically three players: (a) scholars who are typically producers (authors) and consumers (readers) of academic works at the same time, (b) publishers who act as intermediaries between authors and readers, and organize the peer-review process as well as the editorial services in bundling different papers to an issue of a journal publication, whereas the access to academic works is facilitated by (c) libraries who subscribe to sets of journals and bargain on behalf of the group of researchers and (university) students with the journal publishers (Bernius et al. 2009, p. 104). The legal framework that enables interaction between the players is the copyright system. The author of an academic work typically transfers an exclusive commercial right to the publisher. In the end, the relationship between the players in academic publishing are affected by three different market mechanisms.

First, the mechanism characterizing the relationship between a scholar and the publisher is reputation. With a publication of a paper in a particular journal, a scholar receives a quality or reputation signal. This signal reflects the standing of a particular journal in a certain discipline and is hence historically based. As outlined before, the measurement typically referred to for estimating the level of reputation of a particular journal is its impact factor. The impact factor was devised by Eugene Garfield (see Garfield 1955) and measures the average number of citation of a journal in a particular year or period.[4] The impact factor is calculated on a yearly

best allow for additional price discrimination between two separate market segments (authors and readers). See also Bjoerk (2012).

[3]We will further elaborate on the OA model and the characteristics of OA journals and self-archiving in Sect. 3.2.

[4]There are several other factors (e.g. Eigenfactor) that are calculated additionally to the impact factor for measuring the reputation of academic journals. The impact factor has been frequently revised over time. See e.g. Garfield (2005, 2003) on the history and meaning of the impact factor. Critics have been emphasizing alternative measurements for journal reputation, such as the PageRank algorithm of the Google search engine. See e.g. Liebowitz and Palmer (1984) and Kodrzycki and Yu (2006).

basis for journals listed in the Journal Citation Reports (JCR) by Thomson Reuters.[5] The JCR allows the ranking of journals by discipline to not only compare different journals between disciplines, but also within a discipline by means of their impact factor.

Second, actions between publishers and the library are coordinated by a price mechanism. Libraries subscribe to journals or sets of journals for a certain time period—typically multi-year agreements. The subscription price paid by a library is the result of a bargaining process between the two parties. In order to coordinate and bundle similar demands and reach a better bargaining position, libraries often form consortia. With the advent of online publishing, however, "big deal" contracts have become common practice. In this context, libraries purchase their journal subscriptions from large publishers in form of bundled site licenses that allow electronic access to nearly every journal of that publisher. The price for such "big deal" subscriptions depends on the historical expenditures for print subscriptions from the respective publisher.[6] While before the online publishing era institutional subscription prices for universities were identical and independent from previous holdings, the "big deals" offer a contractual strategy for a diversified pricing scheme. Moreover, big deal contracts often contain confidentiality clauses that prohibit that information on prices and contract details are shared between libraries. Finally, the decision on the composition of journals in the "library's basket" depends not only on the price, but is closely linked to the previous reputation mechanism. Thus, journals with a high impact factor form the core in the library's holdings. In an "ideal world" the choice of journals could be simplified to subscriptions to all journals above a certain impact factor threshold. Nevertheless, the prevailing practice of "big deals" and hence the bundling of fixed sets of journals by publishers (journals with high and low reputation) sets the boundaries in the freedom of the libraries' decision making process.

Third and following from the character of a library as an intermediary between publishers and readers, the use of library collections by their scholars (and students) characterizes the last market mechanism. Libraries shall provide with an adequate supply to information for their researchers and (university) students. Accordingly, access to certain journals within the library's collection can be seen as a club good. Club membership is subject to employment (researchers) or university enrollment (students).

In an universal OA regime, however, the role of libraries becomes somewhat obsolete.[7] Scholars, as authors and readers, interact directly with a publisher. The market relationship between the two parties is characterized by both market mechanisms: reputation and price. An author of an academic work pays an author

[5] Visit http://thomsonreuters.com/ (last accessed on September 1, 2014) for more information.

[6] See Bergstrom et al. (2013). An analysis of "big deals" is provided by Edlin and Rubinfeld (2004). For more information and data on journal prices visit http://www.journalprices.com/ (last accessed on September 1, 2014).

[7] Obviously, this conclusion is only true for journal content and not e.g. for books and other media.

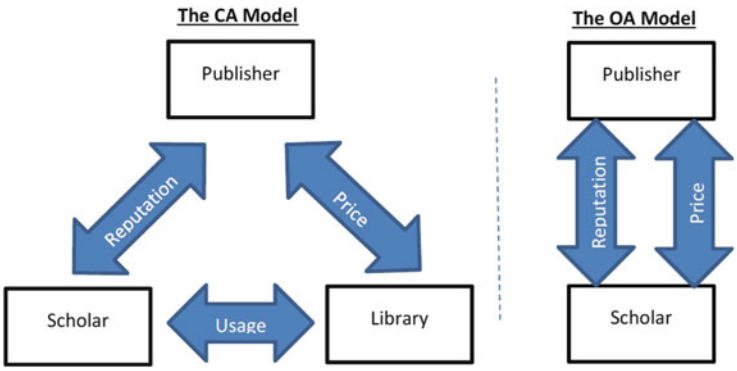

Fig. 3.2 The principles of journal publishing (extending on Bernius et al. 2009, p. 104)

fee to the publisher.[8] In return he receives the reputation signal for a publication in the respective journal. In contrast, the usage of works is not limited by means of individual or institutional subscription. Journal content is freely available via the public internet without any legal, financial or technical barrier other than internet access itself.[9] Figure 3.2 summarizes our findings in comparing the principles of journal publishing between both worlds—the CA and OA mode—and illustrates the players involved and the market mechanism characterizing their relationships.

3.1.2 The Journal Publishing Market: An Industry Analysis

A Brief History of the Journal Publishing Market

The first scientific journals appeared in the late seventeenth and early eighteenth century in central Europe. A period of intense transformation: the Enlightenment. The aim to challenge ideologies that were grounded in tradition and faith and to foster the dissemination of knowledge throughout the society by means of scientific methods led to the launch of the first academic journals. Early academic publishing modes were primarily organized and coordinated by academic associations. The first scientific journal in Europe was the Journal des Scavans (later renamed to the Journal des Savants), which was first published on January 5, 1665, by Denis de Sallo. In England, the Royal Society of London launched the Philosophical Transactions on 6 March 1665.

[8]Note that author fees are not the sole financing source for OA publishers. Frequently OA publishers revert to mixed strategies for covering their publication cost, including e.g. grants and advertising.

[9]See BOAI (2002) for a definition of OA. We will elaborate on the principles of OA in Sect. 3.2.

Most interesting is the relationship that the early academic journals had to the emerging copyright system. Despite the fact that both developments have their origin at about the same time period, there is little evidence of causality. In contrast, Ramello (2010) highlights that "the first two scholarly journals [Journal des Scavans and the Philosophical Transactions] had a somewhat problematic relationship with copyright and its ancestors (Ramello 2010, p. 12). Both journals eventually owe much of their early success and prominence to the presence of pirated copies that were widely used and distributed in France and England. For a long time the relationship between academic journals and copyright remained merely occasional, since academic journals were primarily published by learned societies and then academic institutions (Ramello 2010, p. 13). Even though copyright did not play a vital role in the relationship between publishers and authors at this time, licensing (implicitly or explicitly) became the common framework in shaping the rules. The consequences of this still prevailing contractual framework only became evident when commercial publishers started to enter the market in the 1960s and 1970s. The market entry of commercial publishers did not only happen by launching new titles or by filling niches in the academic journal market, but also on behalf of scientific associations and hence by acquiring existing titles. Over the last years this development has led to a significant concentration in the academic publishing industry (McCabe 2002; Edlin and Rubinfeld 2004; Nicita and Ramello 2007; Ramello 2008, 2010).[10] The consequences of which will be discussed in the next section.

The Distinctive Features of the Journal Publishing Market

The distinct features of the journal publishing market concern all players of the academic journal market. Accordingly, we will first focus on the market characteristics for publishers of academic journals. We will also look at the specific market conditions from the perspectives of researchers and the libraries, before we conclude what follows for our analytical framework.

Publishers

A closer look at the publisher's side of the academic journal market reveals significant differences between commercial and non-commercial publishers as well as between closed and open access journal publishers.[11] The trend towards a higher concentration throughout the last years has led to a situation where basically three commercial publishers dominate the journal market: Reed Elsevier, Springer and

[10] This development was not only observed in the academic journal market, but also in other copyright industries. On the sound recording market see for example Silva and Ramello (2000).

[11] See also Mueller-Langer and Scheufen (2013).

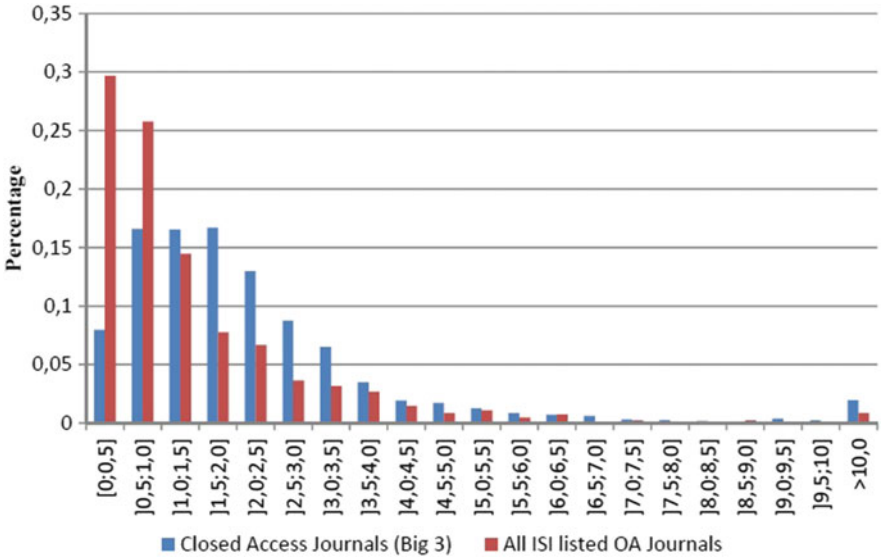

Fig. 3.3 Impact factor distribution: CA journals vs. OA journals

Wiley Blackwell (McGuigan and Russel 2008). In fact, OA journals seem to play hardly any role when comparing journal impact factors between open and closed access journals. Accordingly, journals by established closed access journal publishers, like Reed Elsevier, Springer and Wiley Blackwell, show significantly higher impact factors than those of OA journal publishers.[12] A closer look at the distribution of impact factors among the major publishers of open and closed access journals supports this "reputation advantage" of closed access journals. Figure 3.3 captures the distribution of the impact factors (x-axis) for CA (only the big three) versus OA journals. The y-axis reflects the relative number of CA or OA journals with an impact factor that is within the boundaries of the interval.

Testing the impact factor advantage of CA journals over OA journals shows that CA journals exhibit in fact significantly higher impact factors. Comparing the distribution of all OA journals with all CA journals reveals significant differences in the impact factor distribution. Figure 3.4 shows that OA journals show by far higher frequencies in lower impact factor classes.[13] While 456 and hence about

[12]The following data are own elaborations on data from the ISI Thomson Web of Science database, based on the JCR (2011). The matching data for the OA journals was extracted by using metadata harvesting and hence by programming a web crawler to search the web for the relevant data. See the tables in Figs. 7.1 and 7.2 in the Appendix for more information.

[13]Please note that the difference between "OA (CA) conditional" and "OA (CA) relative" is, that "OA (CA) conditional" reveals the relative amount of OA (CA) journals with an impact factor of *i* conditional to all OA (CA) journals, whereas "OA (CA) relative" reflects the relative amount of OA (CA) journals with an impact factor of *i* in relevance to all journals, i.e. OA and CA

	<1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	≥10	Sum
OA absolute	456	183	85	48	19	13	6	2	3	1	7	823
OA conditional	0,5541	0,2224	0,1033	0,0583	0,0231	0,0158	0,0073	0,0024	0,0036	0,0012	0,0085	1,0000
OA relative	0,0554	0,0222	0,0103	0,0058	0,0023	0,0016	0,0007	0,0002	0,0004	0,0001	0,0009	0,1000
CA	2844	2045	1164	573	286	147	92	52	24	40	144	7411
CA conditional	0,3838	0,2759	0,1571	0,0773	0,0386	0,0198	0,0124	0,0070	0,0032	0,0054	0,0194	1,0000
CA relative	0,3454	0,2484	0,1414	0,0696	0,0347	0,0179	0,0112	0,0063	0,0029	0,0049	0,0175	0,9000
Sum	3300	2228	1249	621	305	160	98	54	27	41	151	8234
	0,4008	0,2706	0,1517	0,0754	0,0370	0,0194	0,0119	0,0066	0,0033	0,0050	0,0183	1,0000

Fig. 3.4 The impact factor advantage of CA journals

55 % of all OA journals have an impact factor of no higher than 1.0, it is 2,844 or about 38 % of all CA journals. CA journals instead reveal significantly higher impact factors in higher impact factor classes. Considering that CA journals have a general market advantage by combining 90 % of all ISI listed journals, the existing market dominance is even more evident. That is, only 10 % of all ISI listed journals are considered to fulfill the conditions of an OA journal (DOAJ definition).[14] The Pearson χ^2 approves this impression of an impact factor advantage of CA journals.[15]

The market dominance of only few commercial publishers becomes even more evident when reverting to market shares as the number of closed versus open access journals with an impact factor of greater or equal to 1.0 (2.0). In this regard, the three giants (Reed Elsevier, Springer and Wiley) manage to combine more than 36 % of all journals with an impact factor greater or equal to 1.0. When considering only journals with an impact factor of at least 2.0, the market share even amounts to almost 37 %. In contrast, the four main OA publishers (including HINDAWI, BioMed, PLoS and Medknow) only publish 2.61 (1.75) % of all ISI listed journals with an impact factor of at least 1.0 (2.0). The average impact factor of an OA journal is 1.44. Looking only at the major four OA publishers, however, journals show on average an impact factor of 2.64, ranging from 0.93 for a journal published by Medknow to an average of 8.51 for the seven journals published by the Public Library of Science (PLoS). However, a maximum impact factor of 16.269 for PLoS Medicine shows that there are outliers for journals of particular disciplines.[16]

Consequently, especially PLoS but also BioMed have established competitive publishing outlets. This fact is also reflected when looking at the relevance of OA journals by discipline. Accordingly, OA journals may primarily be considered as a sufficient publishing outlet in "Biology & Life Sciences", "Health Sciences" as well

journals.That is, the denominator changes when calculating OA_{cond} (CA_{cond}) and OA_{rel} (CA_{rel}), where $OA_{cond,i} = \frac{OA_i}{\sum OA_i}$ ($CA_{cond,i} = \frac{CA_i}{\sum CA_i}$) and $OA_{rel,i} = \frac{OA_i}{\sum OA_i + \sum CA_i}$ ($CA_{rel,i} = \frac{CA_i}{\sum OA_i + \sum CA_i}$), with $i = \{[0, 1[; [1, 2[; \ldots; [10, \infty[\}$.

[14]See http://www.doaj.org/doaj?func=loadTemplate&template=about&uiLanguage=en#definitions (last accessed on September 1, 2014) for the definition of OA. See also Sect. 3.2.

[15]See Fig. 7.3 in the Appendix.

[16]See Figs. 7.1 and 7.2 in the Appendix.

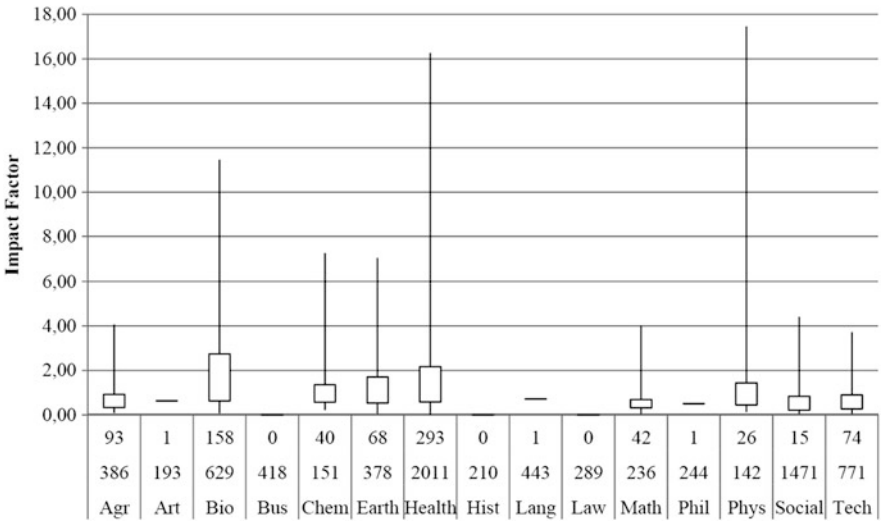

Fig. 3.5 Boxplot—impact factors of OA journals by discipline (*Source*: Mueller-Langer and Scheufen (2013, p. 368))

as in "Physics and Astronomy", whereas it seems not to play any role in fields like "Economics & Business" or "Law & Political Sciences", where not even a single ISI listed OA journal exists.

The boxplot of Fig. 3.5 reveals a bulk of journals in the fields of "Biology & Life Sciences" as well as "Health Sciences" with an impact factor ranging from about 1 (first quartile) to about 2.5 (third quartile), whereas outliers reaching impact factors of above 16 or almost 18 are present in "Health Sciences" and "Physics and Astronomy", respectively.[17] An impression on the distribution of OA journals and ISI listed OA journals by discipline is also readable from the legend of the x-axis. Here, the columns represent the numbers of OA journals and ISI listed OA journals by discipline, where the first row of each column shows the absolute number of OA journals listed by Thomson Reuter's Web of Science (ISI listed), row two the absolute number of all OA journals in the respective discipline and row three the discipline.[18] Obviously, in the fields of "Business & Economics", "History &

[17]See Fig. 7.2 in the Appendix for a detailed picture on the data.

[18]Row three denotes the disciplines, where Agr = Agriculture & Food Sciences, Art = Arts & Architecture, Bio = Biology & Life Sciences, Bus = Business & Economics, Chem = Chemistry, Earth = Earth and Environmental Sciences, Health = Health Sciences, Hist = History & Archeology, Lang = Languages & Literature, Law = Law & Political Sciences, Math = Mathematics & Statistics, Phil = Philosophy & Religion, Phys = Physics & Astronomy, Social = Social Sciences and Tech = Technology & Engineering. The figure is taken from Mueller-Langer and Scheufen (2013).

Archeology" and "Law and Political Sciences" there is not a single journal which is listed by the Web of Science database.

All of the above clearly depicts reality in the academic publishing market and provides evidence to the fact that the prevailing coexistence of closed and open access models is far from reaching a "fair and reasonable" level of competition. Despite the vast increase in the number of OA journals in the past decade, OA publishers still lack in signaling a sufficient level of reputation to attract both readers and authors.

Researchers

The previous section clearly reveals a competitive advantage of established and highly ranked CA journals. There is a young branch of literature that has been investigating the attitude of academics for publishing in either of the two regimes. A survey of 481 researchers from different disciplines by Mann et al. (2008) emphasizes that authors tend to adopt a "wait-and-see" attitude in making use of OA. The authors show that two main variables tend to influence the decision of the publishing outlet: the expected performance of OA and the peer use. Eger et al. (2013) run a survey in Germany for both universities and research institutes. The sample of 2,151 respondents clearly reveals large difference in the attitude to and the experience with both OA models, i.e. OA journals and self-archiving. The pillars in Figs. 3.6 and 3.7 display the experience of researchers from different disciplines in publishing papers in OA journals (light grey) and/or with self-archiving platforms (dark grey) for researchers from both universities (Fig. 3.6) and research institutions (Fig. 3.7). Obviously, OA journals are frequently used as a publishing outlet especially in "Biology & Life Science" and "Health Sciences". Whereas self-archiving is a common model in "Mathematics & Statistics", "Physics

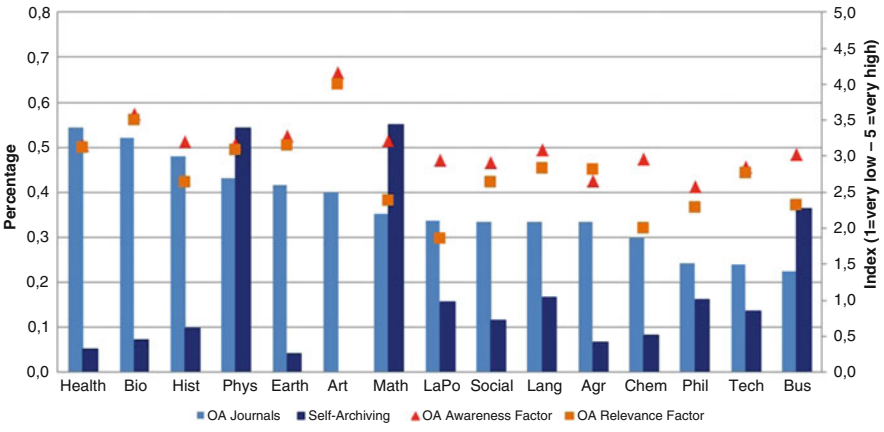

Fig. 3.6 OA in German universities (*Source*: Eger et al. 2013)

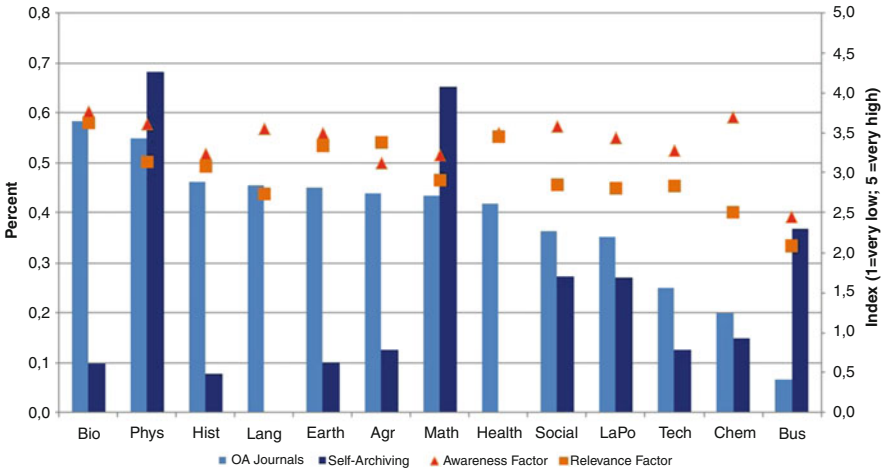

Fig. 3.7 OA in German research institutes (*Source*: Eger et al. 2013)

& Astronomy" as well as "Business & Economics". Interesting in this respect is, that self-archiving is hardly ever used in "Biology & Life Science" and "Health Sciences" which showed significantly higher levels of experience with the gold road of OA publishing. Moreover, the authors introduce two indices to mirror both the personal awareness with the concept of OA and the relevance of OA journals within the respondent's discipline, where 1 = very low, 2 = low, 3 = middle, 4 = high and 5 = very high. That is, the higher the average number reflecting the personal awareness of a respondent or the general relevance of OA journals in one's discipline, the higher was the level of awareness or relevance of OA, respectively. The average count for each discipline is captured in the awareness and relevance factor as an index for knowledge and attitude. The secondary axis in Figs. 3.6 and 3.7 refer to this awareness/relevance factor ranging from 1 = very low to 5 = very high. Not surprisingly, Eger et al. (2013) observe a higher index in such disciplines that exhibited a rather low degree of OA publishing and vice versa.

Accordingly, the immanent rules may explain why OA publishing does not play a vital role in most of the disciplines. The reward system in science and especially the "publish or perish"—environment may somehow force (particularly young) researchers to publish their papers in top-tier journals and hence in journals with high impact. As a consequence, OA journals may be less valuable for the researcher's career concerns.

Libraries

Libraries have been facing considerable changes over the last decade in the way they can negotiate the terms and conditions for journal subscriptions with publishers

("big deals"). As a result, serial expenditures have been steadily increasing over the last 20–25 years. As already discussed, Ramello (2010) provides evidence for increases in serial expenditures by 273 % and serial unit costs by 188 % from 1986 to 2004 in the US, as compared to an increase in the consumer price index of 73 %. Edlin and Rubinfeld (2004) even provide evidence for increases of more than 600 for the time from 1984 to 2001, in disciplines like physics. Similar finding for Europe is provided by Dewatripont et al. (2006). McCabe (2002) shows that the vast increase in subscription prices was at least partially caused by significant mergers between large commercial publishers. A comprehensive overview on the development of journal prices and contract conditions is provided by *Ted Bergstrom* and *R. Preston McAffee*, who have been gathering data and information on journal prices by evaluating university subscription contracts.[19] Accordingly, average journal prices for 2011 were ranging from 109.13 USD in law to 1,486.37 USD in physics for non-commercial publishers, and 713.03 USD in history to 3,174.48 USD in physics for commercial publishers (Bergstrom and McAffee 2013).

Seeking for a solution to the prevailing serial crisis, Parks (2001) points out that librarians may have no incentives to revolutionize academic publishing by moving towards a new business model, only to keep serial costs in line with their budgets. He even argues that some librarians will be motivated to maintain the traditional subscription model to legitimate their employment.

3.1.3 Implications

All of the above shows that the traditional closed access or copyright model is still the dominant business model in place. Basically three big publishers (Elsevier, Springer, Wiley) dominate the market. The OA model plays only a minor role, with some exceptions in disciplines like Biology, Physics and Health Sciences. The reason why researchers still seem to be rather reluctant towards OA is easy to grasp and has its origin in the inherent reward system.[20] Pursuing a career in research requires researchers to receive credit in form of publications in as highly ranked journals as possible. Accordingly, the impact factor is an important signal for a researcher in deciding where to publish her works. Especially young researchers tend to be locked-in, as the competitive environment for tenure track does not allow any deviation from the traditional publishing model. Eger et al. (2013) show

[19]Note that "big deal" contracts often include confidentiality clauses that prohibit that information on prices and contract details are shared between libraries. Nevertheless, most US "states have open records laws that invalidate such clauses and require state institutions including universities to male these contracts publicly available" (Bergstrom et al. 2013).

[20]Recalling the typology of the reward structure in scientific research, researchers are motivated by (1) monetary rewards, (2) peer recognition or reputation and (3) intellectual satisfaction. Nevertheless, it is the reputation that counts as the most important credit for both future job opportunities (CV effects) and a socialization within the peer group.

evidence for a non-linear relationship between age or profession and the disposition towards OA publishing. Thus, the likelihood function for publishing OA reveals an inverted u-shape when the age of a researcher is taken into account.[21] Several scholars (Shavell 2010; Megheli and Ramello 2013; Cavaleri et al. 2009; Bjoerk 2004) have drawn the picture of a chicken-egg problem, where newly launched open access journals will be restricted in accumulating reputation and hence in creating a certain level of demand. The problem for an OA journal then is as follows: In order to build up a certain level of reputation the journal will have to assure readers to read the works and authors to submit high quality works. Readers, however, will prefer particularly highly ranked journals to minimize information cost, while authors are forced to publish in highly ranked journals to attract readers. Thus, in a co-existing system of open and non open access journals researchers tend to be locked-in to the weak Nash equilibrium.[22]

As a consequence, if we believe OA to be superior, we will have to evaluate the instruments that may foster an evolutionary process towards promoting OA publishing. Before we further investigate the costs and benefits of OA and discuss whether an abolishment or other instruments may be a desirable road for shaping the future of academic publishing, we will have a closer look at the OA movement for understanding its principles and development.

3.2 The Open Access Movement

3.2.1 The Open Access Principles

The concept of OA as an initiative or movement to provide free and unrestricted access to scientific knowledge was first to be defined by the Budapest Open Access Initiative (BOAI). Accordingly, open access to scientific works is defined by means of a "free availability on the public internet, permitting any user to read, download, copy, distribute, print, search or link to the full text of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the Internet itself." (BOAI 2002). In this context, OA to scholarly journal literature can be achieved by means of two complementary strategies: (1) Self-Archiving ("the green road") and (2) OA journals ("the gold road").[23]

[21] Similar findings are provided by Megheli and Ramello (2013) for a subset of disciplines, especially for the field of law and economics.

[22] See Hanauske et al. (2009) for a game theoretical analyzes on the incentives of researcher deciding whether to submit to a CA or OA journal. We will pick up on this issue in Chap. 5.

[23] The notion of a green and gold road of OA follows Harnad et al. (2004).

Self-archiving offers scholars the tools and assistance to deposit their published or unpublished works in so-called archives or repositories.[24] Authors may decide to deposit their works to either subject-based and/or institutional repositories. While a subject-based repository bundles research results of specific research fields, institutional repositories provide the option for self-archiving of research output by institution. In practice, several examples for both types of self-archiving exist. Famous for subject-based repositories are ArXiv.org and PubMed. The pre-print server ArXiv.org currently offers open access to more than 860,000 e-prints in physics, mathematics, computer science, quantitative biology, quantitative finance and statistics.[25] PubMed comprises over 21 million citations for biomedical literature from MEDLINE, life science journals and online books, covering the fields of biomedicine and health, life sciences, behavioral sciences, chemical sciences and bioengineering.[26] In economics, the "Research Papers in Economics" (RePEc) is the world largest collection of working papers, journal articles and software components. The RePEc database currently provides free online access to more than 1.4 million research papers from more than 1,700 journals and 3,700 working paper series. Currently more than 35,000 authors are registered at RePEc.[27] In contrast, institutional repositories are mostly run by the libraries belonging to an institution. The creation, location and growth of OA institutional repositories and their contents is indexed by the "Registry of Open Access Repositories" (ROAR).[28] More than 2,200 institutional and 250 cross-institutional repositories have been registered in ROAR, where the majority (1,236) is located in Europe. The use of institutional repositories has especially gained momentum since 2004. While first institutional repositories were already set up in the 1990s, the usage of self-archiving jumped up to more than 150 new repositories per year since 2004 and peaking in 2010 with almost 500.[29] In this context, the University of Southhampton (UK) and the Lund University (Sweden) abound as the most famous examples for institutional repositories.

The "gold road" to OA adapts the general principles of scholarly publishing by offering a peer-review of submitted papers for quality selection. The OA movement promotes both the launch of a new generation of journals committed to OA and

[24] A directory listing OA repositories is http://www.opendoar.org/ (last accessed on September 1, 2014).

[25] See http://arxiv.org/ (last accessed on September 1, 2014).

[26] See http://www.ncbi.nlm.nih.gov/pubmed/ (last accessed on September 1, 2014).

[27] For more information on RePEc see their website at http://repec.org/ (last accessed on September 1, 2014). Obviously, the high number of registered authors as well as the high frequencies of the RePEc usage shows their relevance in online publishing. Some authors have even advocated the usage of download numbers for measuring researcher's performance. See for example Zimmermann (2009) on academic rankings with RePEc.

[28] ROAR is hosted at the University of Southhampton (UK) and is financed by JISC. See the website of ROAR at http://www.roar.eprint.org/ (last accessed on September 1, 2014) for more information.

[29] See http://roar.eprints.org/view/year/ (last accessed on September 1, 2014).

the transition of existing journal titles to OA. OA journals are consistent to the traditional publishing model in so far, as they shall provide with the same publishing services and particularly exercise quality control on submitted papers through an editor, editorial board and/or a peer-review system. However, OA journals do not invoke copyright to restrict access. Instead, copyright and other tools shall ensure immediate and continuous open access to journal content. In this regard, journals generally revert to Creative Commons[30] licenses which can also be used to specify usage rights. The "Public Library of Science" (PLoS) and BioMed Central as the leading OA publishers, for example, apply the so-called Creative Commons Attribution License (CCAL). The CCAL allows authors to retain their copyright, but allows anyone to download, reuse, reprint, modify, distribute and/or copy articles from the respective journal. Springer Open Choice,[31] as a commercial publisher, uses the Creative Commons Attribution Non-Commercial License, which allows readers to read, copy and distribute a work and to create derivative works for non-commercial purposes. As OA journals are by definition accessible without paying any subscription or access fee, journal publishers have to turn to other forms for covering their expenses. The BOAI lists "many alternative sources of funds for this purpose, including the foundations and governments that fund research, the universities and laboratories that employ researchers, endowments set up by discipline or institution, friends of the cause of open access, profits from the sale of add-ons to the basic texts, funds freed up by the demise or cancelation of journals charging traditional subscription or access fees, or even contributions from the researchers themselves." (BOAI 2002). As seen before, there are several types or different degrees of OA journals. The "pure" or "true" OA model only considers journals as OA if they follow the lines of the BOAI definition. These "pure" OA journals are listed by the "Directory of Open Access Journals" (DOAJ), currently listing more than 9,900 OA journals (September 2014).[32] Much more common are so-called hybrid models, where publishers and libraries apply only a weak form of OA by either providing optional, retrospective, delayed or partial OA. However, Bernius et al. (2009) argue that in contrast to the green and gold roads of OA these hybrid models do not fully satisfy the intended purpose of the OA declarations.

[30]The Creative Commons (CC) model was particularly influenced by the books of Lawrence Lessig (Lessig 1999, 2001, 2004), a law professor from Stanford (US). In general, the CC model offers six licensing models that allow authors to specify certain usage rights to their works. See the CC website at http://creativecommons.org/ (last accessed on September 1, 2014) for more information. On the differences between OA and CC see e.g. Spindler (2008). We will further elaborate on the general principles but also the drawbacks of the CC licensing scheme and hence the need for a reform of the prevailing licensing models in Sect. 4.2.

[31]See the website of Springer at http://www.springer.com/open+access/open+choice?SGWID=0-40359-0-0-0 (last accessed on September 1, 2014).

[32]Section 3.2.3 provides with an statistical analysis of the OA journal market. For more information on the DOAJ visit their website at http://www.doaj.org/ (last accessed on September 1, 2014).

3.2.2 *The Open Access Movement: A Brief History*

SPARC and the Open Access Movement

The historical origins of the OA movement can be traced back as far as to the 1960s.[33] As a first milestone in the history of OA, the literature frequently refers to the launch of the "Educational Resources Information Center" (ERIC)[34] in 1966. Before the 1990s, journal articles and working papers were primarily disseminated by use of electronic mailing lists (Laasko et al. 2011, p. 1). Only with the advent of the internet and the spread of digital technologies, the OA model was more frequently adopted in the scientific community. The first free scientific online archive has become known as ArXiv.org at Los Alamos National Library and was launched on August 16, 1991. In 1993, the statistician Gene Glass followed by launching the first peer-reviewed OA journal—the "Education Policy Analysis Archive" (Willinsky 2009, p. 53). Despite these "early shots", the number of OA journals as well as platforms for self-archiving increased only slowly in the 1990s (Laasko et al. 2011).

It was not until 1998 that the OA movement began to gain momentum, especially due to the efforts of the "Scholarly Publishing and Academic Resource Coalition" (SPARC). In 2001, a group of researchers circulated an open letter to establish "an online public library that would provide the full contents of the published record of research and scholarly discourse in medicine and the life sciences in a freely accessible, fully searchable, interlinked form" (PLoS 2001). The letter was signed by 34,000 scholars around the world and finally led to the launch of the "Public Library of Science" (PLoS). The OA movement gained political weight with a number of public statements. The three most important statements are the "Budapest Open Access Initiative" (2002), the "Bethesda Statement on Open Access Publishing" (2003) and the "Berlin Declaration on OA to Knowledge in the Sciences and Humanities" (2003). The BOAI was launched by the Open Society Institute (OSI) on February 14, 2002. The primary contribution of the BOAI was to eventually provide with a first definition of the OA concept. The initiative gained a broad consensus in the scientific community and was signed by more than 4,000 individuals as well as 365 institutions (Opderbeck 2007, p. 108; Kuhlen 2008, p. 477). The Bethesda statement was released in June 2003 and can be seen as the first step for encouraging faculty and grant recipients of signing institutions to utilize the instruments of OA publishing. Extending on the Bethesda statement, finally, the Berlin declaration of October 22, 2003, established a binding commitment among the Max Planck Institute in Germany and other leading research organizations in

[33] Peter Suber provides a detailed overview on the historical origins of OA with his "Timeline of the Open Access Movement". Suber stopped updating his timeline on February 9, 2009. In present, the Open Access Directory allows for peer editing of this document to provide an updated overview. See http://www.earlham.edu/~peters/fos/timeline.htm (last accessed on September 1, 2014).

[34] See http://www.eric.ed.gov/ (last accessed on September 1, 2014).

Germany, France and Switzerland to encourage researchers and grant recipients of signing institutions to publish their research output by following the OA principles (Opderbeck 2007, pp. 108 et seq.; Schirmbacher 2007, p. 25). Afterwards it was signed by 371 organizations, mostly from Europe, but also including the "Library and Informations Association of South Africa" (since October 6, 2011), the "Indian National Science Academy" (since April 5, 2004) and the "National Natural Science Foundation of China" (since May 24, 2004). The "BBB-definition (Budapest, Bethesda, Berlin) for open access" (Suber 2004) created not only the foundation for all subsequent conferences, but has been put into action by several private grant funders around the world. Consequently, the OA principles were subsequently encoded into public policy and even positive law in Europe, the United States and in the international IPR arena (Opderbeck 2007, pp. 109 et seq.).

Open Access in National Legislation and Public Policy

United States

The United States of America can be seen as the pioneer and natural origin of the OA movement. As a matter of fact, there had been first steps towards an unrestricted and free sharing of research output even before the birth and spread of the internet. With the launch of the "Educational Resources Information Center" (ERIC) by the U.S. Department of Education, the Office of Educational Research and Improvement as well as the National Library of Education, and MEDLINE by the National Library of Medicine in 1966, the US initiated the first OA projects of the world. Both ERIC and MEDLINE are still online. Moreover, the US Department of Defense followed with its launch of the Advanced Research Projects Agency Network (ARPANET)—as the direct ancestor of the internet—primarily the purpose of easing the access and sharing of research output (Suber 2006).[35]

The implementation of OA policies especially gained momentum throughout the launch and endeavour of two OA advocacy organizations: (1) the Scholarly Publishing and Academic Resource Coalition (SPARC) and (2) Public Knowledge (PK).[36] SPARC was founded by Rick Johnson in 1998 and is a coalition of currently nearly 800 institutions in North America, Europe, Japan, China, and Australia.[37] Even though its primer purpose was to enhance competition in the market for academic journals, SPARC became an active advocate for OA since the Budapest Open Access Initiative in February 2002. Ever since SPARC has been actively promoting OA publishing, especially by means of campaigns (e.g. the

[35] See footnote 33 of this chapter.

[36] Suber (2006) highlights also other important organizations such as the Alliance for Taxpayer Access (ATA) and the Open Access Working Group (OAWG).

[37] Visit the SPARC website at http://www.arl.org/ (last accessed on September 1, 2014) for more information.

Publisher Assistance Program and the Publisher Partner Program) and guidelines for stakeholders (e.g. the Authors Addendum (for authors), the Directory of Open Access Programs (for librarians and administrators) or the OA Sponsorship Guide (for journal publishers)). Moreover, SPARC initiated the SPARC Open Access Forum which was launched in July 2003 and is moderated by Peter Suber.[38] PK was founded in 2001 and speaks for the public interest in information policy (Suber 2006, p. 8). PK initiated an OA project in 2003 that is directed at promoting both the gold and green road by informing policy makers and the public about the critical role of OA publishing inside the US and internationally. Suber (2006) points out that both SPARC and PK had been active in promoting OA publishing before the US congress asked the National Institute of Health (NIH) for OA policies in 2004.

In July 2004, the US congress instructed the NIH to develop an OA policy that would require NIH grantees to deposit a copy of their (NIH funded) works on PubMed Central (PMC) 6 months after their publication in a peer-reviewed journal. However, the final version of May 2005 fell short of this objective in two respects. First, the requirement was substituted by a request. Second, the permissible delay was extended to 12 months after the publication date (Suber 2006, p. 10). In NIH (2005) the policy "requests and strongly encourages that authors specify posting of their final manuscripts for public accessibility as soon as possible (and within 12 months of the publisher's official date of final publication)" (NIH 2005). Despite the weaknesses of the NIH policy, the NIH was the first agency to actively ask for OA archiving of their funded research results. Suber (2006) highlights that the NIH was also a good agency to do this first step, since "the NIH is the world's largest funder of medical research, and its 2005 budget, at $28 billion, was larger than the gross domestic product of 142 nations. The NIH policy simply applies to more literature than any other single initiative is ever likely to cover - about 5,500 peer reviewed journal articles per month." (Suber 2006, p. 10). Subsequent discussions—also influenced by the American Center for Cures Act (introduced in the US Senate in 2005) and the Federal Research Public Access Act (introduced to the US Senate in May 2006)—induced several revisions of the original NIH policy of May 2005. In January 2008 the NIH released a revised OA policy, now making OA archiving of NIH funded research mandatory. The revision "shall require that all investigators funded by the NIH submit or have submitted for them to the National Library of Medicine's PubMed Central an electronic version of their final, peer-reviewed manuscripts upon acceptance for publication, to be made publicly available no later than 12 months after the official date of publication" (NIH 2008). More revisions or add ons of the NIH policy followed in 2008 (7 March and 23 September), 2009 (19 March, 12 August and 30 October), on 16 November 2012 and on 9 January 2013.

[38] Another important discussion forum devoted to OA issues is the American Scientists Open Access Forum, initiated in 1998 and moderated by Stevan Harnad.

Europe

In Europe the history of OA policy developments initially began to gain momentum with the Berlin declaration. The first country to encode the OA principles was the United Kingdom (UK). In 2004, the UK Parliament's "Select Committee on Science and Technology" (SCST) issued a report that promotes the implementation of an OA publishing regime (Opderbeck 2007, p. 109). The report lists 83 conclusions and recommendations that greatly highlight the effectiveness of the OA model. In particular, the committee suggests that the Research Councils should require authors to deposit copies of publicly funded research in institutional repositories and that funds should be made available to cover publication costs. Furthermore, the committee recognizes the need for international coordination and recommends that the UK Government should "act as a proponent for change on the international stage and lead by example" (SCST 2004, p. 97). In 2005, one of the greatest research funders—the Research Councils UK (RCUK)—issued a mandate that required authors who received funding by the Research Councils to deposit their works in an OA archive. In October 2006, also the Wellcome Trust—a UK-based charitable foundation and one of the world's largest research funders—implemented an OA policy that requires "electronic copies of any research papers that have been accepted for publication in a peer-reviewed journal, and are supported in whole or in part by Wellcome Trust funding, to be made available through PubMed Central (PMC) and UK PubMed Central (UKPMC) as soon as possible and in any event within 6 months of the journal publisher's official date of final publication" (*Wellcome Trust, Open Access Policy)*.[39] In Germany, similar OA initiatives were issued after the Berlin declaration, particularly driven by support from the "German National Scholarship Foundation" (Deutsche Forschungsgemeinschaft, DFG). In January 2006, the DFG adopted a policy in which it requires that DFG funded research results should be made available digitally and on the Internet by means of OA.[40] The implementation process was fostered by the "Alliance of German Science Organisations". The members, e.g. the "Max Planck Gesellschaft" (MPG), committed to implement a policy to require research faculty members to deposit a copy of all their published works in an OA repository and encouraged their researchers to publish their research results in OA journals wherever a suitable OA journal exists. In reaching this goal, e.g. the MPG and the Humboldt University of Berlin created a document and publication server (edoc) to offer the necessary organisational and technical framework to all staff members for providing OA to their works.[41]

[39]Visit the website of the Wellcome Trust at http://www.wellcome.ac.uk/About-us/Policy/Policy-and-position-statements/WTD002766.htm (last accessed on September 1, 2014).

[40]For more information see http://www.dfg.de/en/research_funding/programmes/infrastructure/ (last accessed on September 1, 2014).

[41]See e.g. the "Document and Publication Server of Humboldt-Universität Berlin" at http://edoc.hu-berlin.de/e_info_en/policy.php (last accessed on September 1, 2014).

The EU Commission started to take considerable action in implementing OA policies for academic publishing in 2006. The efforts at the European level followed a report by the EU Commission in January 2006, in which the commission highlights the need to promote the OA model for taking action against anticompetitive bundling practices by journal publishers. In particular, the report suggests to (i) establish a European policy mandating published articles arising from EC-funded research to be available after a given time period in open access archives, and (ii) explore with Member States and with European research and academic associations whether and how such policies and open repositories could be implemented (ECReport 2006, p. 11). The developments at the European level especially began to gain momentum in 2007 and 2008, when the EU Commission launched two OA initiatives.[42] In December 2007, the ERC Scientific Council published its "Guidelines for Open Access" as a follow up on the EC Report. In August 2008, the EC Commission complemented this initiative with the launch of the "Open Access Pilot in FP7". Both initiatives followed the statement made in the EC Report to require that researchers provide OA to every article that has been the result of EC funded research.[43] In the following years the OA principles were implemented in all EU member states.[44] In this context, especially the DRIVER project[45] helped to establish and create OA repositories in each of the member states and stimulated OA archiving by promoting policy developments on the national level. In addition, several initiatives—like the OpenAIRE initiative in cooperation with stakeholders like SPARC Europe, COAR or LIBER—supported the further expansion of OA repositories and created awareness on the various OA possibilities among researchers and research faculties. Overall, the various OA initiatives in Europe show a strong tradition of OA models in academic publishing and highlight the efforts in establishing both an infrastructure of OA repositories as well as OA journals.

International IPR Policy

At the international level it was primarily through the efforts of the "Organization for Economic Co-operation and Development" (OECD) that the OA principles became recognized. In 2004, in total 35 OECD member states, including Germany,

[42]The history of both initiatives as well as recent news on OA developments in Europe can be followed on the website of "Open Access Infrastructure for Research in Europe". Visit their website at http://www.openaire.eu/ (last accessed on September 1, 2014) for more information.

[43]The EU Commission provides with a comprehensive set of resources to explain the details of the "Open Access Pilot in FP7" at http://www.openaire.eu/en/support/ec-resources (last accessed on September 1, 2014).

[44]See http://www.openaire.eu/en/open-access/country-information (last accessed on September 1, 2014) for information on OA policies in each of the member states of the EU.

[45]Visit their website at http://www.driver-repository.eu/ (last accessed on September 1, 2014) for more information.

France, the UK and the US signed the "Declaration on Access to Research Data from Public Funding"[46] in which they declared their commitment to work towards the establishment of an OA regime for digital research data from publicly funded research activities. A first move towards encoding the OA principle into the international policy making framework was the "Access to Knowledge" (A2K)[47] treaty in 2004. The draft treaty emerged throughout a call from Brazil and Argentina for a development agenda for the WIPO and was primarily intended to ease the transfer of knowledge to the developing world (Opderbeck 2007, pp. 113 et seq.). During a series of meetings in 2005 a draft of the treaty was prepared by representatives from developing countries as well as representatives from the UK and the US, including a catalogue of exceptions to copyright that essentially mirror the "fair use" or "fair dealing" concepts. In particular, the "A2K" treaty would generally limit copyright law akin to existing compulsory licensing provisions (Opderbeck 2007, p. 115; Helberger 2005). A concept that is already included in the "Agreement on Trade Related Aspects of Intellectual Property Rights" (TRIPS),[48] but has seldom been used in the past.[49] Furthermore, the "A2K" draft treaty includes sections on the limitation of digital right management (DRM) systems (article 3-6), copyright term extension (article 3-9) and compulsory licensing of copyrighted works in developing countries (article 3-12). Part 5 of the draft further specifies ways for "expanding and enhancing the knowledge commons". Accordingly, any work "resulting from government-funded research shall be publicly available at no charge within a reasonable time frame, subject to reasonable exceptions, for example, for classified military research, for patentable discoveries, and for works that generate revenue for the author, such as books." (article 5.2(a)). In addition, a knowledge commons committee (KCC) shall "promote cooperation and investment in databases, open access journals and other open knowledge projects that expand the knowledge commons." (article 5-1). Within two meetings in February and June 2006, finally, the committee chair proposed to move forward on proposals that had received consensus support. This proposal was rejected by developing countries that claimed significant IPR reforms. In fact, the proposal followed primarily interests of the US and the European states which was considered as a back-room maneuver

[46] See the "Declaration on Access to Research Data from Public Funding", adopted on January 30, 2004, available at http://www.codata.org/archives/2005/UNESCOmtg/dryden-declaration.pdf (last accessed on September 1, 2014).

[47] For the draft of the "Access to Knowledge" treaty see http://www.cptech.org/a2k/a2k_treaty_may9.pdf (last accessed on September 1, 2014). More general information on the "A2K" movement is provided at http://www.cptech.org/a2k/ (last accessed on September 1, 2014).

[48] See TRIPS (1994).

[49] Art. 13 of the TRIPS agreement specifies that exceptions to exclusive rights shall be made only in "certain special cases which do not conflict with a normal exploitation of the work and do not unreasonably prejudice the legitimate interests of the right holder." We will elaborate on the general principles of this so-called (Berne) three-step test and its drawbacks in Sect. 4.2.

by developing countries (Opderbeck 2007, pp. 116 et seq.). Consequently, the draft of the proposed treaty has ever since been in debate.[50]

Especially with respect to developing countries the OA movement has still affected the international policy through four programmes run under the patronage of "Research4Life" and initiated by the "World Health Organization" (WHO), the "Food and Agriculture Organization" (FAO), the "United Nations Environment Programme" (UNEP) and the "World Intellectual Property Organization" (WIPO). The "Research4Life" programmes generally seek to provide free or reduced fee access to research in health, agriculture and the environment for all eligible countries in the developing world. Institutions in eligible countries are universities, colleges, research institutes, professional schools, extension centres, government offices, local non-governmental organizations (NGOs), hospitals and national libraries. The history of "Research4Life" started in 2002 when the WHO, the Yale University and six major publishers[51] launched the "InterNetwork Access to Research Initiative" (HINARI),[52] providing access to peer-reviewed journals covering medicine, nursing and related health and social sciences. In October 2003 a similar model was employed for research in food and agriculture with the "United Nation's "Access to Global Online Research in Agriculture" (AGORA),[53] which was initiated by the FAO of the United Nations and nine founding publishers.[54] Accordingly, AGORA provides with free or low-cost access to peer-reviewed journals in agriculture and related fields to public institutions in developing countries. The "Research4Life" initiative was finally supplemented by the "Online Access to Research in the Environment" (OARE)[55] initiative in 2006, where OARE is directed at providing access to scholarly literature in the area of environmental research. OARE was launched by UNEP, the Yale University and leading science and technology publishers.[56] Only recently, the WIPO together with its partners in the publishing

[50]There are several initiatives that have tried to foster the development of OA in science at the international level. For example, the NECOBELAC project seeks to build a network of collaboration between the EU and countries in Latin America and the Caribbean (LAC). See http://www.necobelac.eu/ (last accessed on September 1, 2014) for more information.

[51]Among them were Blackwell, Elsevier Science, the Harcourt Worldwide STM Group, Wolters Kluwer International Health & Science, Springer Verlag and John Wiley.

[52]Visit their website at http://www.who.int/hinari/en/ (last accessed on September 1, 2014) for more information.

[53]Visit their website at http://www.aginternetwork.org/ (last accessed on September 1, 2014) for more information.

[54]Among them are Blackwell Publishing, CABI Publishing, Elsevier, Kluwer Academic Publishing, Lippincott, Williams & Wilkins, Nature Publishing Group, Oxford University Press, Springer Verlag and John Wiley & Sons.

[55]Visit their website at http://www.oaresciences.org/ (last accessed on September 1, 2014) for more information.

[56]See http://oare.oaresciences.org/content/en/partners.php (last accessed on September 1, 2014).

industry[57] launched the "Access to Research for Development and Innovation" (ARDI)[58] initiative. Starting in 2009 and joining "Research4Life" on August 23, 2011, this initiative has been providing free online access to major scientific and technical journals to local, not-for-profit institutions in least-developed countries and low-cost access to industrial property offices in developing countries across the world. We will elaborate on these initiatives in Sect. 4.2 by analyzing the impact of OA as a means to assist developing countries in bridging the knowledge gap and to involve all nations in science. Before, we will have a closer look at the attempts to actually create OA journals in the academic publishing market.

3.2.3 The Rise of Open Access Journals: Some Descriptive Statistics

The development of OA journals can be investigated by using data from the "Directory of Open Access Journals" (DOAJ), listing only journals that follow the lines of the BOAI definition of OA.[59] Accordingly, the DOAJ defines OA journals as journals that are freely available via the internet and provide the reader with the right to read, download, copy, distribute, print, search, or link to the full texts of articles.[60] By the time of writing this section in January 2013, the DOAJ listed more than 8,600 OA journals, where more than 3,700 journals are searchable at article level and almost 776,000 articles are made freely available. The growth rate of DOAJ has been steadily increasing and shows that on average more than three titles were added to DOAJ per day in 2011. Figure 3.8 shows the development of the number of OA journals added to DOAJ from 2002 until 2012.[61] The pillars refer to the number of newly launched OA journals by year. The line graph shows the development of the aggregated number of OA journals over time, i.e. the added number of all journals minus the number of eliminated titles in the respective year. The pillars revert to the primary axis, while the line graph reverts to the numbers as displayed on the secondary axis.

[57] In this regard, the WIPO cooperated especially with 12 major publishers in the field of development and innovation. The publishers are: American Association for the Advancement of Science, American Institute of Physics, Elsevier, Institute of Physics, John Wiley & Sons; Oxford University Press, National Academy of Sciences, Nature Publishing Group, Royal Society of Chemistry, Sage Publications, Springer Science+Business Media; Taylor & Francis.

[58] Visit their website at http://www.wipo.int/ardi/ (last accessed on September 1, 2014) for more information.

[59] The following statistics were surveyed by the author. Data was obtained by programming a web crawler and using metadata harvesting from DOAJ. See OAI (2008) for more information on the metadata harvesting tool.

[60] Visit the DOAJ website at http://www.doaj.org/ (last accessed on September 1, 2014) for more information.

[61] Please note that the data was extracted in October 2012.

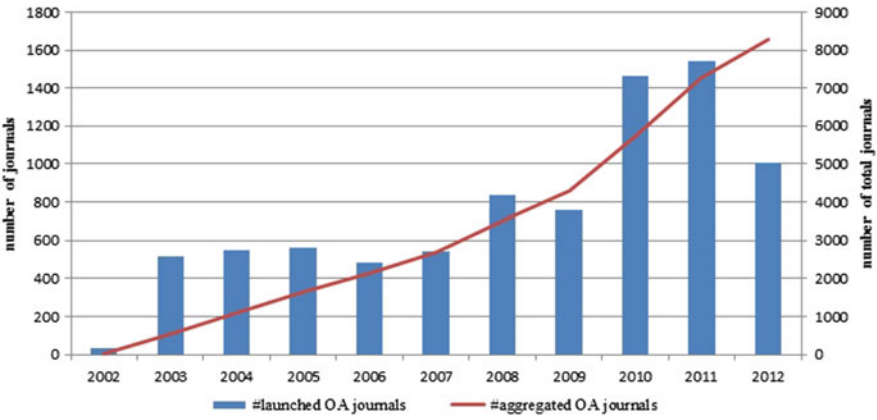

Fig. 3.8 Development of OA journals: 2002–2012

Obviously, the total number of OA journals increased vastly from around 33 in 2002 to almost 8,500 journals by the end of 2012. While there was a steady increase of journals added to DOAJ by more than 400 on average in the period between 2003 and 2007, the number of newly launched OA journals almost doubled for the years 2008 and 2009, reaching on average almost 800 newly launched OA journals per year. The number doubled again for the period after 2009, reaching an absolute yearly growth rate of more than 1,400 OA journals, peaking in 2011 with 1,538 newly launched OA journals. The number of launched newly OA journals by the time of data extraction was 1,005 for the year 2012.[62]

Interesting in this respect is the development of OA journals by country.[63] Figure 3.9 clearly shows that the United States has been most active with 1,211 OA journals listed in the DOAJ by October 2012. Among the pioneers of OA publishing in 2002 were the United States with 19 journals (57 %), the United Kingdom with 5 journals (15 %) and Germany with 3 journals (9 %).[64] However, with Brazil and India also two developing countries belong to the top 5 of the most active countries in launching OA journals. Accordingly, in 2012 Brazil and India ran a total number of 801 and 463 OA journals, respectively. Brazil and India are closely followed by Egypt on rank 6 with 350 journals in 2012. The percentage distribution of OA journal by country has changed considerably from 2002 to 2012.

[62]See the Appendix for detailed data on the development of OA journals over time. Here, Figs. 7.4 and 7.5 also give an overview on the development of OA journals by discipline. All of the data was extracted in October 2012 by programming a web crawler and using metadata harvesting from DOAJ; see OAI (2008).

[63]The numbers of Fig. 3.9 were taken from the website of the DOAJ at http://www.doaj.org/doaj?func=byCountry&uiLanguage=en (last accessed on September 1, 2014).

[64]The percentages in brackets reveal the relative amount of OA journals published by country compared to the total amount of OA journals in the respective year (in 2002; 33 OA journals).

#	Country	Number of Journals added to DOAJ and *Total Number of Journals in* ***DOAJ***										
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	USA	19	196	85	86	51	87	177	105	158	217	90
		19	215	300	386	437	524	701	806	964	1181	1271
2	Brazil	0	8	117	47	51	55	72	44	135	131	141
		0	8	125	172	223	278	350	394	529	660	801
3	UK	5	106	41	39	39	31	31	56	117	45	65
		5	111	152	191	230	261	292	348	465	510	575
4	India	0	14	17	14	16	17	22	48	127	93	95
		0	14	31	45	61	78	100	148	275	368	463
5	Spain	0	5	16	58	49	27	62	27	77	72	49
		0	5	21	79	128	155	217	244	321	393	442
6	Egyps	3	0	1	4	8	17	28	66	31	126	66
		3	3	4	8	16	33	61	127	158	284	350
7	Germany	4	12	20	34	26	32	27	23	36	29	17
		4	16	36	70	96	128	155	178	214	243	260
8	Canada	0	24	11	10	15	15	26	30	46	44	34
		0	24	35	45	60	75	101	131	177	221	255
9	Romania	0	4	1	0	7	5	12	36	80	71	33
		0	4	5	5	12	17	29	65	145	216	249
10	Italy	0	4	9	18	16	12	12	28	45	48	37
		0	4	13	31	47	59	71	99	144	192	229

Number added
Total Number

Fig. 3.9 OA journals by country: from 2002 until 2012 (*Source*: *DOAJ*)

In this regard, the dominance of the USA has been steadily decreasing over the last years, with currently about 14 % of all OA journals published by US publishers. Nevertheless, it becomes evident that there are regions, especially in the developing world, that hardly contribute to the pool of OA journals. Here, the Sub-Saharan African countries are far from publishing 1 % of all OA journals in present.[65]

Also striking is that the disposition to the idea of OA publishing differs considerably between different fields of research. In this context, Health Sciences is most active in OA publishing with 2,011 or 24.3 % of all OA journals. This is followed by the fields of social sciences with 1,471 (17.8 %), technology and engineering with 771 (9.3 %) and biology and life sciences with 629 (7.6 %) OA journals. As such, these four subjects combine almost 60 % of the total amount of OA journals published until 2012.[66] In business and economics in total 418 journals are published that follow the definition as stated by the DOAJ, with 241 journals assigned to business management subjects and 177 journals in economics. Consequently, this provides evidence for the fact that not all disciplines pay equal attention to the OA model. A standardized GINI-coefficient of 0.502 (where $0 \leq G^* \leq 1$) endorses this impression of a fairly high concentration rate in the

[65]Own calculations based on country data provided by the DOAJ. See http://www.doaj.org/doaj?func=byCountry&uiLanguage=en (last accessed on September 1, 2014) for the data.

[66]Note that the total number of journals differs with 8,286 from the previously stated number as not all journals are categorized accordingly.

Journal Subject	n_i	q_i	v_i	h_i	H_i
Physics and Astronomy	142	0,017	0,017	1/16	1/16
Chemistry	151	0,018	0,035	1/16	2/16
Arts and Architecture	193	0,023	0,059	1/16	3/16
History and Archaeology	210	0,025	0,084	1/16	4/16
Mathematics and Statistics	236	0,028	0,112	1/16	5/16
Philosophy and Religion	244	0,029	0,142	1/16	6/16
Law and Political Science	291	0,035	0,177	1/16	7/16
Others	310	0,037	0,214	1/16	8/16
Earth and Environmental Sciences	378	0,046	0,260	1/16	9/16
Agriculture and Food Science	388	0,047	0,307	1/16	10/16
Business and Economics	418	0,050	0,357	1/16	11/16
Languages and Literatures	443	0,053	0,411	1/16	12/16
Biology and Life Science	629	0,076	0,487	1/16	13/16
Technology and Engineering	771	0,093	0,580	1/16	14/16
Social Sciences	1471	0,178	0,757	1/16	15/16
Health Sciences	2011	0,243	1,000	1/16	1,00
Sum	**8286**	1,000		**1,00**	

Fig. 3.10 Distribution of OA journals by discipline: GINI coefficient

distribution of OA journals by discipline. Figure 3.10 summarizes the facts on the distribution of OA journals by discipline, where n_i = absolute number of journals in discipline i, q_i= relative number of journals in discipline i, v_i = cumulative percentage of journals (i.e. $v_i = \sum_{a_i \leq x} q_i$), h_i = percentage distribution over disciplines and H_i = cumulative percentage of the distribution over discipline (i.e. $H_i = \sum_{a_i \leq x} h_i$).

As a shift towards the OA model comes along with a change from the "reader pays" principle to the "author pays" principle, it may also be interesting to see how the publishers of OA journals have coped with this challenge. In October 2012, in total 2,335 OA journals (28.24 %) raised author fees for accepted journal articles. The majority of 5,510 (66.63 %) had no author fees.[67] An amount of 210 (2.54 %) had conditional author fees. No information was provided for 214 (2.59 %) OA journals. In this respect, Chang (2003) shows that open access publishers have to consider different income sources to recoup their first copy costs. First and foremost, public grants, endowments and subscriptions to print versions emerge as promising options in addition to a charge of a publication fee per article. Figure 3.11 provides an overview on the largest OA publishers and their income sources.

Obviously, there is evidence for additional income sources than charging an authors' fee per article. In particular, the Public Library of Science (PLoS)[68] received a $9 million start-up grant from the Gordon and Betty Moore Foundation

[67]The evaluation follows calculations based on DOAJ data generated through metadata harvesting on 15 October 2012.

[68]See http://www.plos.org/ (last accessed on September 1, 2014).

Publisher	Type	# Journals	Main Income Sources	Publication Fees (US $)
BioMed Central (BMC)	commercial	232	publication fees	0 - 2,365 (standard: 1,945)
Public Library of Science (PLoS)	non-commercial	7	publication fees grants	1,350 - 2,900 (standard: 2,250)
Hindawi Publishing Corporation	commercial	>300	publication fees print subscriptions	0 - 1,500
Medkow Publications	commercial	182	print subscriptions advertising	0

Fig. 3.11 OA publishers and their main income sources (*Source*: updated figure from Chang 2003)

as well as financial support by other grantors.[69] The Hindawi Publishing Cooperation[70]—a commercial publishers of more than 300 OA journals—charges in addition to a publication fee per article—amounting up to $1,500—from the author(s) of a work also print subscriptions which range from $195 to $1,895 (2012 rates).[71] In contrast, Medkow Publications[72] does not charge authors for paper submissions, but realizes income streams by means of print and online advertisements as well as reprint purchases for distribution.

All of the above reveals the increasing relevance and prevalence of OA publishing in the market for science, with currently more than 9,900 OA journals listed by the DOAJ (numbers of September 2014). Meanwhile, all types of market actors—commercial, non-commercial and scientific societies[73]—have been engaged in the OA movement. While some publishers still only provide with hybrid models of OA, which do not fully satisfy the purpose of intended OA declarations, also a large number of "true" OA examples abound in practice. Especially in recent times several new steps have been taken for promoting and strengthening the OA principles in academic publishing. The following section shall highlight some of these recent developments.

3.2.4 Recent Developments

There have been several new developments in the last view years. As a review of all recent initiatives, policies and movements is way beyond the scope of this

[69] See http://www.plos.org/about/index.php (last accessed on September 1, 2014) for a list of the grantors who supported PLoS.

[70] See http://www.hindawi.com/ (last accessed on September 1, 2014).

[71] See http://www.hindawi.com/subs/ (last accessed on September 1, 2014).

[72] See http://www.medkow.com/ (last accessed on September 1, 2014).

[73] Conney-McQuat et al. (2010) provide a case study, revealing that OA may particularly offer solutions to challenges which are faced by some scientific societies.

subsection, we would like to elaborate on two general perspectives and some developments that have gained most attention in the public debate.[74]

First, there have been recent steps by policymakers in setting a legal framework and introducing policies for the promotion of OA publishing of publicly funded research. In this regard, the new OA policy by the "Research Councils UK (RCUK)" has gained most attention. In its new OA policy from 16 July 2012 the RCUK follows the recommendations of the "Working Group on Expanding Access to Published Research Findings" (the Finch Report). Most importantly, the report recommended a clear policy direction in the UK towards fostering OA journal publishing. The OA policy issued on 16 July 2012 clearly states that all academic works that "result from research that is wholly or partially funded by the RCUK (1) must be published in journals which are compliant with Research Council policy on Open Access, and; (2) must include details of the funding that supported the research, and a statement on how the underlying research materials such as data, samples or models can be accessed."(RCUK 2012b, p. 1, paragraph 3). Regarding the first section, the paragraph 4 in RCUK (2012b) specifies the compliance with journals. Accordingly, a journal is compliant with the RCUK OA policy if (1) the journal itself provides immediate and unrestricted access to the final paper version via the journal's website; or if (2) the journal allows to deposit a final version of the paper (including all changes that result from peer review) in other repositories, without any restriction on non-commercial re-use and within an embargo period of 12 months. The payment of an "Article Processing Charge (APC)" is ensured through block grants to universities and eligible research organizations.[75] The receipt of funding is further specified in paragraph 5 of RCUK (2012b). Paragraph 6, finally, specifies the rules on implementation and compliance. Thus, the policy applies to all RCUK funded research papers that are submitted for publication from 1 April 2013. In a workshop on 13 November 2012 the Research Councils further discussed and agreed upon rules for the monitoring of the OA policy.[76] In Germany, the recent developments show a two sided approach towards OA publishing. Besides the implementation of OA policies from funding agencies and the "alliance of science organizations", a discussion on the implementation of a so-called inalienable right of secondary publication for authors of academic works has been induced at the governmental level. On 10 April 2013 the German government introduced a bill for a reform of §38 UrhG, covering not only the implementation of an authors right for secondary publication, but also issues related to the orphan works problem.[77] The bill shall provide the author of an academic work with the right to re-use her

[74]For a review on recent developments in digital copyright beyond the academic publishing debate see Eger (2013).

[75]An overview on the eligible research institutions and the amount of grants received is provided under http://www.rcuk.ac.uk/documents/documents/RCUK_APCfundDistribution.pdf (last accessed on September 1, 2014).

[76]For a note of the meeting see RCUK (2012a).

[77]On the orphan works problem see e.g. Dahlberg (2011). For the bill see RegE (2013).

publication for non-commercial purposes after an embargo period of 12 months after publication. In particular, the new bill shall enable the researcher to deposit a copy of her publication on a repository. On 3 May 2013, the German Federal Council (Bundesrat) even strengthened the position of academic authors by reducing the embargo period from 12 months to only 6 months after publication.[78] The bill is still pending (as of July 2013), but has already released a storm of controversy not only among publishers but also within the group of researchers themselves.[79]

Second, there are several steps that have been taken by universities and research institutions or even by groups of researchers themselves. In Germany, for instance, the "alliance of science organizations" has been fostering the implementation of institutionalized OA mandates for German research organizations such as the "Max Planck Gesellschaft" (MPG) or the "Leibniz Gemeinschaft". In this regard, the MPG has been promoting the OA publishing mode within its research institutions by means of an OA policy and information services. Most attention has been directed to the establishment of the "Max Planck Digital Library (MPDL)". The MPDL provides with an online platform for the exchange of publications by affiliated authors. Thus, the MPDL may be seen as a MPG internal repository, where MPG researchers deposit their works for an unrestricted access to institutional members. Another central part within the MPG Open Access framework is the Open Access Policy Team, consisting of researchers and librarians of the MPG. The OA policy team meets on regular basis and offers information services on issues related to OA publishing. Similar developments can be observed in other countries and covering both universities and research institutes. The "Registry of Open Access Repositories Mandatory Archiving Policies" (ROARMAP) currently lists more than 500 OA mandates, covering e.g. institutional mandates (177), thesis mandates (103) and funder mandates (81). The majority with more than 50 % of all OA mandates are located in Europe (261), followed by the United States with 119 OA mandates.[80] However, Suber (2012) highlights that there are no gold OA mandates. All OA mandates target green OA and hence encourages or requests self-archiving of academic works in subject or institutionally based repositories. Last but not least, there are several examples of individual groups of researchers that have either argued in favor of OA in general or have even forwarded a boycott of researchers towards certain closed access publishers, indirectly advocating the OA publishing mode. A famous example is the boycott of researchers against the practices of Reed Elsevier. In spring 2012, more than 3,000 academics, including several Fields Medal

[78] See Bundesratsbeschluss (2013).

[79] Note that there is not only opponents of the OA publishing mode within the group of publishers, but also within the group of researchers. In this regard, a group formation known under the name "Heidelberger Appell" has been criticizing the development of OA publishing. The initiative was founded by Roland Reuß. Some of their critical aspects forwarded against OA will also be discussed in Chap. 5. See http://www.textkritik.de/urheberrecht/index.htm (last accessed on September 1, 2014) for more information.

[80] All numbers show the status on 22 July 2013. For an updated overview visit the website of ROARMAP at http://roarmap.eprints.org/ (last accessed on September 1, 2014).

winning mathematicians, signed a petition to boycott journals published by Elsevier, with commitments ranging from a refusal to submit papers to Elsevier journals to a boycott of editorial or proof reading tasks.[81]

In conclusion, several steps towards OA publishing in science have been taken. Nevertheless, a comprehensive analysis comparing and analyzing both systems in their pure form has not been done. Only recently has the topic aroused the interest of scholars in law and economics. Since Shavell (2010), several authors have been analyzing different aspects of an intriguing question in the era of digital publishing: Is a copyright or an open access regime better suited for the organization of academic publishing? The prevailing co-existence of both regimes is clearly far from reaching a first best solution, as several weaknesses such as the impact factor advantage of established CA publishers or the application of hybrid OA models prevent from having a competitive market for academic journals. Accordingly, the following chapter will explicitly be dedicated to analyze both the organization of science, comparing both systems from a social welfare point of view, and the international political economy and hence the question which policy steps may be optimal in shaping the future of academic publishing.

[81] See also Eger and Scheufen (2012b) on page 54.

Chapter 4
On the Access Principle in Science: A Law and Economics Analysis

4.1 The Organization of Science: Open Access vs. Copyright

This section provides a comprehensive analysis comparing both systems from a social welfare point of view and hence asking whether academic publishing should be organized by means of a universal closed or open access mode. The first subsection is an extensive view on both regimes and their impact in the light of the publishing game and hence the prevailing "publish or perish"—environment in scientific research. The impact on researcher's private incentives to write high quality papers will be investigated as well as the social welfare effects when shifting towards an universal OA regime. Several robustness checks and a model extension to think outside the box of the model's inherent contest character provide a broad picture on the superiority of either regime. The second subsection picks up on the distributive effects from shifting towards an "author pays" principle when introducing OA as the dominant publishing mode, briefly highlighting some possible distortions that may result in an obviously heterogeneous world. In this regard, especially the consequences for developing countries will be addressed, providing the analytical framework for investigating the international political economy of access to scientific knowledge in Sect. 4.2 of this chapter.

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4.1.1 *Academic Copyright in the Publishing Game: A Contest Perspective*[1]

Introduction

As we have seen previously, the literature addressing OA principles in academic publishing can broadly be structured in three lines of research: (i) studies on the economic impacts of alternative publishing models on the scholarly system as a whole, (ii) studies assessing the effects of open access on readership and citations, and (iii) studies investigating researchers' attitude and behavior towards open access (see the literature review below). In this subsection, we will primarily address the first literature stream. Most of this literature shares the two fundamental assumptions that scientists are hardly motivated by (small) royalties, and that social welfare increases in the incentives set for scientists due to positive externalities. We do not doubt the importance of positive research externalities, but we argue that the rent-seeking character of research may nevertheless lead to incentives that are excessively high from a social perspective.[2] This is the motivating force of our paper.

Starting point of this subsection is that, similar to competing for promotion or for prizes in professional sports, we also find elements of a zero-sum game in the academic publishing game. This bears the risk of rent-seeking activities, and hence ceteris paribus of incentives that are excessively high.[3] In reality, this risk is likely to be reinforced by the multi-task character of academics' obligations: whereas the research output is relatively easily measurable and consequently strongly incentivized, this is more difficult for teaching and administrative work, and hardly possible for the contribution to a productive work atmosphere by supporting other people.[4] Thus, taking additionally into account that effort incentives might be relatively distorted towards research,[5] it seems not far-fetched that incentives

[1]This section is joint research with *Eberhard Feess* (Frankfurt School of Finance and Management). However, this subsection presents a shortened version of the original model in Feess and Scheufen (2013). In particular, the model extensions (robustness) are not presented here, but will be discussed in the conclusions.

[2]See Congleton et al. (2008) on the theory of rent-seeking.

[3]Of course, such a perspective does not necessarily contradict the relevance of intrinsic motivation. See e.g. the case studies discussed in Andreff and Szymanski (2006) on intrinsic motivation in tournaments. As we have seen, there are two types of intrinsic motivation in scientific research: community-based intrinsic motivation (peer recognition/reputation) and enjoyment-based intrinsic motivation (intellectual satisfaction).

[4]See the seminal contribution on multi-tasking by Holmström and Migrom (1991), followed by a large body of literature showing that incentives are often distorted as only easily measurable activities are rewarded. We will further elaborate on these insights in Chap. 5.

[5]This is a direct consequence of the "publish or perish" environment of scientific research. Obviously, researchers are "locked-in" to a system that gives credit only based on publications and rankings. Meho (2007) finds empirical evidence that more and more of research has been produced, but is hardly ever read. The author shows that only 50 % of all peer-reviewed journal

for research may be either too low *or* too high. In this paper, we do not take the multi-task character of the academic profession explicitly into account, but restrict attention to the contest perspective.

Specifically, we adopt the canonical Tullock-contest model[6] for analyzing the publishing game between scientists, and we argue that such a model complements the common view on research in three aspects: first and already mentioned, we emphasize that incentives for research are only too low if the rent-seeking activities of academic contest do not exceed the positive externalities from academic publishing in general. Second, efforts in contest models do not only depend on stakes (that is in our context on readership, reputation and career effects), capabilities and effort costs, but also on the equilibrium behavior of competitors. Thus, the contest perspective adds new factors to the determination of effort in academic publishing which seem to have been widely neglected so far. Third, equilibrium effort levels in Tullock-contests are decreasing in the competition's asymmetry. We will argue that this is important for the problem at hand, and our view is based on the argument that switching from a closed to an open access-mode is likely to increase the gap between researchers from top and mediocre universities.

Primarily two institutional assumptions drive our analysis. First and foremost, we argue that the most talented researchers tend to be at the best universities. Obviously, as a university's ranking reflects the sum of its researcher performances (see Crane (1965), and more recently Goodall (2006, 2009)) likely justifies that these two aspects are mutually conditional.[7] Second and in contrast to Shavell (2010), we assume that mediocre universities will often not fully pay for the submission fees under open access. This may be debatable. Nevertheless, considering Germany as an example, even the moderate submission fees under closed access are currently not fully covered by all universities. Many professors at public universities have rather small budgets they can allocate among different objectives, and submitting papers reduces the funds left for attending conferences or for hiring student assistants. Furthermore, some (top) universities cover also the considerably higher submission fees for fast tracks in journals while others do not. Given that submission fees with open access would be much higher, assuming that (some) authors would have to

articles are ever read by anybody else but the reviewers and the authors. About 90 % of all articles are never cited. See also Laband and Tollison (2003). We will pick up on the negative incentives of "publish or perish" in Chap. 5.

[6] See Konrad (2009) for a comprehensive overview on contest models.

[7] Crane (1965) provides evidence that scientists at major schools also attract higher peer recognition than researchers at minor universities.

care about them seems reasonable.[8] This aspect may particularly gain recognition when considering developing countries.[9]

In Feess and Scheufen (2013) we integrate these two institutional factors in a stylized contest-model with two types, a more talented academic working at a top institution covering the submission fees, and a less talented academic employed by a mediocre institution not covering the fees. We derive the following results: First, when moving from closed to open access, there are countervailing effects with respect to the effort incentives—open access leads to higher efforts if and only if higher readership outweighs the incentive-reducing impact of the submission fees borne by the low type. Notably, the high type's equilibrium effort is also decreasing in the low type's submission fees due to the contest's larger heterogeneity. Second, if private effort incentives are too low, because the externality effect outweighs the rent-seeking effect, then it depends on the model's parameters which of the two publishing modes is superior. Third, open access is always superior when private effort incentives are excessively high, and we will provide a clear-cut intuition for this result after it has been developed.[10]

Let us briefly discuss why we think that the contest perspective is important. As any model of strategic competition, the contest perspective implies that participants take their behavior mutually into account. To see why we believe that this is often the case, consider Management Departments in Germany as an example. In twentieth-century-Germany, publications in international journals played a minor role for career opportunities in the academic management profession, which depended mainly on academic ancestry and book publications. Very recently, this has radically changed and teaching loads as well as the allocation of internal funds are now largely contingent on the position in a ranking based on a standardized scoring system for journal publications. Roughly, a few hundred academics in Germany may currently be qualified for publishing at a regular basis in respected journals, and many of them seem in fact concerned about the research output of their colleagues. Moreover, anecdotal evidence supports the view that it is far from obvious whether efforts are strategic substitutes or complements: Some (strong) academics tell that they respond to fiercer competition by enhancing their effort, while others seem to focus

[8]Costs for a single publication, for example in a Public Library of Science (PLoS) journal, currently ranges from $1,350 (PLoS ONE) to $2,900 (PLoS Biology or PLoS Medicine). See http://www.plos.org/journals/pubfees.html (last accessed on September 1, 2014). Besides, King (2007) estimates that the average fixed costs for publishing a single article is $3,000.

[9]We will elaborate on this aspect in Sect. 4.1.2.

[10]Please note that our model seeks a welfare comparison of both pure systems, i.e. we do not analyze the decisions of scientists between coexisting regime (closed versus open access), but the assume that all scientists publish under the same mode. Consequently, our paper does not address the previously mentioned problem of an inefficient Nash equilibrium in a system where both publishing modes coexist. For a game theoretical analysis of this aspect see e.g. Hanauske et al. (2009).

on different things. This is nicely reflected in the Tullock-contest where it depends on types whether efforts are, in equilibrium, strategic substitutes or complements.[11]

The remainder of this section is organized as follows. First, we will present the general model. We then turn to a discussion of the impact of a pure closed versus open access regime from an individual and social welfare perspective. We will conclude by discussing the main insights gained and the robustness of the model in terms of different specifications of the contest model.

The Model

There are two differently talented scientists $i = H, L$ competing for publishing an article by exerting quality effort e_i. The asymmetry in capabilities is modelled by assuming that the papers' quality is $q_i = \theta_i e_i$ where θ_i expresses author i's talent. Without loss of generality, we normalize $\theta_L = 1$ and set $\theta_H \equiv \theta > 1$ to capture the high type's predominance. The probability of getting a paper published depends on quality, but only in a stochastic way to account for the unpredictability of the publishing game. The respective winning probabilities are therefore expressed by an asymmetric Tullock-contest, that is, $p_H = \frac{\theta e_H}{\theta e_H + e_L}$ and $p_L = \frac{e_L}{\theta e_H + e_L}$.

As most academics including ourselves enjoy doing research even if the outcome's quality may be questionable, effort costs can best be seen as opportunity costs. We assume that the two types' effort cost functions are the same, which expresses the view that research capabilities are not systematically related to the talent required for administrative work, consulting or teaching.

We consider two regimes $k = C, O$ denoting closed and open access, respectively. By g_i^k, we define the submission fee covered by author type i under regime k. With academic copyright (closed access), we assume that there are no submission fees, that is $g_i^C = 0$, $i = H, L$. This is counterfactual, but all we need is that submission fees are higher with open access. The part of the submission fee borne by authors with open access is denoted $g_i^O \equiv g_i$, and for the reasons discussed in the introduction we assume that $g_H^O = 0$ while $g_L^O \geq 0$.

The authors' benefit from publishing depends on the reputation of the journal and on readership which we denote as r^k. Realistically, we assume that readership is (weakly) higher with open access, that is $r^O = 1 \geq r^C$.[12]

Summing up, the Tullock-contest can be described by the two types' objective functions

[11] While top universities dominate the ranking, it contains also many academics from smaller institutions with lower reputation, and rules on the coverage of submission fees are quite different. Notwithstanding the fact that the ranking is subject to reasonable criticism, it has high incentive effects.

[12] Normalizing readership with open access to 1 is without loss of generality.

$$V_L = \left(r^k - g_L^k\right)\left(\frac{e_L}{\theta e_H + e_L}\right) - e_L \tag{4.1}$$

$$V_H = r^k\left(\frac{\theta e_H}{\theta e_H + e_L}\right) - e_H, \tag{4.2}$$

which will be maximized with respect to e_i.

Under both systems, the authors maximize their objective functions as given in Eqs. (4.1) and (4.2), respectively. Taking the first order conditions and solving for the equilibrium yields

$$e_H^* = \frac{\left(r^k\right)^2 \theta\left(r^k - g_L^k\right)}{\left(r^k(1+\theta) - g_L^k\right)^2}, \tag{4.3}$$

$$e_L^* = \frac{r^k \theta\left(r^k - g_L^k\right)^2}{\left(r^k(1+\theta) - g_L^k\right)^2}. \tag{4.4}$$

Recalling that $r^O = 1 \geq r^C$ and $g_L^O \geq 0$ while $g_L^C = 0$, we get the results summarized in Proposition 1:

Proposition 1 *(i) All privately optimal effort levels are increasing in readership and decreasing in the two types' heterogeneity, that is,* $\frac{\partial e_i^k}{\partial r^k} > 0$, $\frac{\partial e_i^k}{\partial \theta} < 0\ \forall i, \forall k$.

(ii) With closed access, the two types' effort levels are identical, $e_H^C = e_L^C$.

(iii) With open access, the high type's effort is higher than the low type's effort if the low type's submission costs are positive, that is if $g^O > 0$. *Both effort levels are decreasing in the low type's submission cost,* $\frac{\partial e_i^O}{\partial g^O} < 0\ \forall i$.

All proofs are provided in the Appendix.

The first part of *part (i)* is obvious as the marginal benefit from effort is increasing in readership. The second part of *part (i)* is a standard feature of Tullock-contests which says that effort incentives are decreasing in the contestants' heterogeneity. Intuitively, the bad type decreases her effort as the (marginal) probability of winning is lower, and the good type responds accordingly as she is likely to win even with relatively low effort.[13]

Part (ii) says that, even so effort levels are decreasing in heterogeneity, both effort levels are identical in equilibrium if the heterogeneity refers solely to abilities. The reason is that the effort-decreasing impacts of heterogeneity are the same for both types. Thus, effort levels are the same for closed access.

[13]Both properties also hold for the more general case where $p_H = \frac{\theta(e_H)^t}{\theta(e_H)^t + (e_L)^t}$ and $p_L = \frac{(e_L)^t}{\theta(e_H)^t + (e_L)^t}$. In this more general version, t captures the degree of discrimination, that is the sensitivity of winning the contest to the efforts taken by the players.

Things are different with open access if and only if the low type bears higher submission costs (*part (iii)* of the Proposition). As the heterogeneity then refers to costs and not to abilities, the impact on the two types is no longer identical—both types reduce their efforts, but the bad type to a larger degree so. Assuming heterogeneity with respect to cost structures hence has different consequences from assuming heterogeneity with respect to abilities. Note that the low type's submission costs do not only reduce his effort, but also the high type's effort due to the strategic effect described for *part (i)* of the Proposition.

We now proceed by comparing the effort levels under the two systems, and we state the results in Proposition 2.[14]

Proposition 2 *(i) The low type's effort is higher with open access than with closed access if and only if* $\frac{r^O}{r^C} > \frac{(1+\theta-g)^2}{(1+\theta)^2(1-g)^2}$. *(ii) The high type's effort is higher with open access than with closed access if and only if* $\frac{r^O}{r^C} > \frac{(1+\theta-g)^2}{(1+\theta)^2(1-g)}$. *(iii) Both types' efforts are more likely to be higher under open access if the heterogeneity* θ *and the low type's submission costs* g *are low. (iv) The ratio between the high and the low type's effort is higher for open access.*

Part (i) of the Proposition expresses the trade-off of the two regimes for the low type's effort incentives: On the one hand, open access leads to a higher readership and thereby to a higher incentive for effort. The strength of this effect depends on the readership-ratio r^O/r^C. On the other hand, the effort incentive is lower since part of the publishing costs must be borne privately by the low type. The strength of this effect depends on g. More interestingly, *part (ii)* says that the high type's effort may also be lower with open access even though the readership is larger, and even though the high type pays no submission fees by assumption. As outlined after Proposition 1, this follows from the fact that efforts are strategic complements, that is, the high type reduces her effort in response to the low type's lower effort provision.

Part (iii) of the Proposition shows that the two types' heterogeneity expressed by θ has less impact on effort provision under closed access. The reason is that the contest's additional asymmetry caused by the low type's submission costs aggravates the negative impact of the asymmetry in abilities. The impact of the submission costs itself is straightforward.

Part (iv) is likely to be important from a social welfare-perspective as one might presume that the high type's effort is socially more valuable (see the next section). Formally, the result is a straightforward implication of the fact that the two types' efforts are identical with closed access, while the high type exerts relatively higher effort under open access.

[14] As submission costs are only positive for the low type under open access, we will subsequently write g instead of g_L^o for short.

Social Welfare

So far, we have only considered the private incentives under the two regimes, but we have not yet extended to social welfare. We use a utilitarian welfare function which is additively separable in the utilities of readers and authors. The authors' (net) utilities follow directly from substituting their equilibrium effort levels into their objective functions. We neglect the low type's submission costs under open access as these are purely re-distributive. Thus, it remains to specify the utility of readers which we define in a reduced form as

$$U = \beta r^k \left(q_H^{0.5} + q_L^{0.5}\right). \tag{4.5}$$

Such a utility function for readers seems quite natural and displays the following features: first, the two terms in brackets express that the readers' utility is increasing at a decreasing rate in the quality of the articles. Second, the readers' utility is higher for open access as $r^O = 1 \geq r^C$. This is straightforward as the audience for articles of a given quality will be higher it they can be downloaded for free.[15] Note that, similar to the low type's submission costs, we do not incorporate the prices of articles as they cancel out (publishing houses get what readers and authors pay). Thus, all that counts for articles of a given quality is readership itself. Third, $\beta > 0$ is just a factor expressing the average utility of readers from articles of a given quality.

Adding up over the utilities of readers and authors yields the social welfare function

$$SW = \beta r^k \left(q_H^{0.5} + q_L^{0.5}\right) + r^k \left(\frac{\theta e_H}{\theta e_H + e_L}\right) + r^k \frac{e_L}{\theta e_H + e_L} - e_H - e_L. \tag{4.6}$$

Recalling that $q_H = \theta e_H$ and $q_L = e_L$, and that the winning probabilities add up to one, the social welfare function is

$$SW = \beta r^k \left((\theta e_H)^{0.5} + e_L^{0.5}\right) + r^k - e_H - e_L. \tag{4.7}$$

Note that, as usual in contest models, the winner's identity does not matter from a social welfare perspective. The socially optimal effort levels are given by maximizing SW with respect to e_L and e_H. We get

$$e_H^f = \frac{\left(r^k\right)^2 \theta \beta^2}{4}, e_L^f = \frac{\left(r^k\right)^2 \beta^2}{4}, \text{ and } \frac{e_H^f}{e_L^f} = \theta^{16} \tag{4.8}$$

[15] In our non-strategic model below, we follow Shavell (2010) by deriving readership explicitly as a function of prices. Including this in a contest-model, however, would yield a very convoluted model structure and would add nothing to the points we wish to make.

[16] Superscript "f" denotes "first best".

It follows that the high type should exert higher effort due to her higher (marginal) productivity in research. This could also be interpreted in the sense that universities should assign lower teaching and administration loads to highly qualified researchers which is the case in some universities and countries, but not in all. Second, due to higher readership ($r^O = 1 \geq r^C$), socially optimal effort levels are higher under open access.

The relation between the privately and the socially optimal effort levels under the two regimes is expressed by Lemma 1.

Lemma 1 *(i) For closed access, the high type's (the low type's) effort is too low iff* $\beta > \frac{2}{\left(r^C\right)^{0.5}(1+\theta)}$ $\left(\beta > \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)}\right)$. *(ii) For open access, the high type's (the low type's) effort is too low iff* $\beta > \frac{2(1-g)^{0.5}}{1+\theta-g}$ $\left(\beta > \frac{2\theta^{0.5}(1-g)}{1+\theta-g}\right)$. *(iii) If* $\beta > \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)}$, *then both efforts are too low under both regimes. (iv) For* $g \geq 1 - \frac{1}{\theta}$, *both efforts are too high under both regimes if* $\beta < \frac{2\theta^{0.5}(1-g)}{1+\theta-g}$. *For* $g < 1 - \frac{1}{\theta}$, *both efforts are too high if* $\beta < \frac{2(1-g)^{0.5}}{1+\theta-g}$.

Most generally expressed, Lemma 1 shows that the relationship between the privately and socially optimal incentives for research depends on whether the utility of readers outweighs the rent-seeking impact of career concerns. Under both open and closed access, privately optimal efforts are more likely to be too low if the good type's productivity increases, that is, if θ is high. The reason is that a higher productivity of the good type is fully reflected in social welfare, but reduces both effort levels due the contest's increasing asymmetry. Moreover, under open access, private efforts are more likely to be too low when the low type's submission costs are high as those reduce efforts for two reasons, the cost effect and the strategic effect from the contest's asymmetry.[17] Parts *(iii)* and *(iv)* of the Lemma state conditions ensuring that both efforts are too high or too low under either system. The case distinction in part *(iv)* is required as either the high or the low type's effort may define the threshold for β.

We can now turn to a comparison of social welfare under closed and open access. Substituting the effort levels into the respective social welfare functions yields

$$SW^C = \beta r^C \left(\left(\frac{r^C \theta}{(1+\theta)^2} \right)^{0.5} + \left(\frac{r^C \theta^2}{(1+\theta)^2} \right)^{0.5} \right) - \frac{2r^C \theta}{(1+\theta)^2} + r^C \tag{4.9}$$

[17] The differences in the private and socially optimal efforts with open access are $\Delta e_L^O \equiv e_L^O - e_L^f = \frac{\theta(1-g)^2}{(1+\theta-g)^2} - \frac{\beta^2}{4}$ and $\Delta e_H^O \equiv e_H^O - e_H^f = \frac{\theta(1-g)}{(1+\theta-g)^2} - \frac{\theta\beta^2}{4}$ which gives derivatives of $\frac{\partial \Delta e_L^O}{\partial g} = -\frac{2\theta^2(1-g)}{(\theta-g+1)^3} < 0$ and $\frac{\partial \Delta e_H^O}{\partial g} = -\frac{\theta(g+\theta-1)}{(\theta-g+1)^3} < 0$.

$$SW^O = \beta\left(\left(\theta\frac{\theta\,(1-g)}{(1+\theta-g)^2}\right)^{0.5} + \left(\frac{\theta\,(1-g)^2}{(1+\theta-g)^2}\right)^{0.5}\right) - \frac{\theta\left(2+g^2-3g\right)}{(1+\theta-g)^2} + 1. \tag{4.10}$$

Regardless of whether the qualities provided are above or below the socially optimal ones, there are two advantages of open access: Readership is larger and efforts of the two types are different. Still, for analyzing the welfare ranking of the two systems, we need to distinguish between the situations where efforts are below or above the socially optimal ones. Proposition 3 refers to the first case:

Proposition 3 *Suppose all efforts are too low, i.e.* $\beta > \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)}$. *Then, open access is more likely to be welfare superior if* r^C, θ *and* g *are low.*

Recall first that we know from Lemma 1 that all efforts are too low if $\beta > \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)}$. Then, social welfare is increasing in the two quality efforts. This given, the impact of the three variables is straightforward: first, efforts under closed access are increasing in readership r^C which makes it less likely that open access is superior.[18] Next, a higher θ is more beneficial under closed access as, with open access, even the high type's effort is decreasing in the low type's publication costs. And the higher θ, the higher is the optimal effort that should be provided by the high type. For similar reasons, open access becomes less favorable when submission costs g are high. Note that, given that both efforts are inefficiently low, $g \to 0$ is a sufficient condition for the superiority of open access.

We now turn to the case where quality efforts are above the socially optimal ones. Proposition 4 shows that the welfare ranking of the two regimes is then clear-cut:

Proposition 4 *Suppose all efforts are efficient or too high, i.e.* $\beta < \frac{2\theta^{0.5}(1-g)}{1+\theta-g}$ *for* $g \geq 1-\frac{1}{\theta}$ *and* $\beta < \frac{2(1-g)^{0.5}}{1+\theta-g}$ *for* $g < 1-\frac{1}{\theta}$. *Then, open access is superior to closed access.*

For an intuition, let us neglect the difference in readership for a moment. Then, open access always yields lower equilibrium efforts due to the asymmetry in the coverage of publication costs. Hence, as efforts are above the socially optimal ones by definition of the case considered, open access is superior even when readership is the same. And as higher readership is always beneficial and is higher with open access, open access is superior. Thus, while the ranking between the two systems is ambiguous if effort levels are too low, it is clear-cut if they are too high.

[18] Recall that r^C implicitly measures the readership with closed access *relative* to open access as r^O is normalized to one.

Discussion and Conclusion

In conclusion, our model shows that there may be countervailing effects from shifting towards a pure OA regime. Assuming that scientists are also motivated by career concerns, we find that private research incentives can, from a social perspective, be too high when the rent-seeking motive outweighs the positive externalities of research. If incentives are too high, open access is always superior. The reason is that readership is larger while effort incentives are lower due to the asymmetry in privately borne publication costs. If quality effort incentives are too low, the welfare ranking of the two regimes depends on whether the higher readership under open access outweighs the detrimental impacts of asymmetric costs on effort provision. Our paper adds to the literature by analyzing the contest character of academic publishing. Accordingly, the conclusions we derive differ from the non-strategic model in Shavell (2010) where incentives for writing a paper can never above the socially optimal ones. We do not argue that our contest model is the only perspective in the debate. However, we do think that we add an important puzzle to the debate in academic publishing by emphasizing that there may be rent-seeking incentives for researchers in the predominant "publish or perish" environment in academic career advancement.

Furthermore, we do understand concerns that our results may be driven by the special characteristics of our contest model in place. That is the reason why we test the robustness of our model with respect to different contest model specification in Feess and Scheufen (2013).[19] In particular, we present two model specifications. First, we model heterogeneity between the two types of researchers by means of different cost functions, i.e. our two researchers do no longer differ in their productivity but their cost of effort.[20] The argument is then as follows: our two researchers face different costs when exerting quality efforts in writing an academic work. For modelling this heterogeneity in the cost functions we assume that the high type benefits from a cost advantage.[21] Integrating different cost functions in Feess and Scheufen (2013), we show that the results of our main model do not qualitatively change. Second, we integrate type-specific readership. The argument behind this model specification is easy to grasp: as reading an article is costly, the utility a reader gains from reading an article of a give quality may be type-specific and higher for the high type researcher. This seems reasonable due to differences

[19]For reasons of clarity we refrain from presenting the specific model extension here, but focus on a short discussion and the results. Please see Feess and Scheufen (2013) for a detailed presentation.

[20]Note that differences between the cost functions of the players in the contest is an often applied alternative for modelling heterogeneity in tournaments. See also the overview in Konrad (2009).

[21]In our model this is captured by arguing that the effort costs are $\theta_i e_i$, where $\theta_h < \theta_l$ determines that the high type has a cost advantage over the low type researcher.

in the reputation of authors.[22] We integrate the argument of type-specific readership by introducing a parameter of reputation in our social welfare function, allowing that reading an article of an author with high reputation comes along with a higher benefit.[23] Again, our results reveal that our original contest model is robust with respect to the different variants of the contest model.[24]

Turning to further research, natural questions seem whether a coexistence of the two systems outperforms each standing alone system, and whether uncoordinated market behavior would induce such a coexistence. Accordingly, if a unique open access is superior, one might ask if markets will enforce such a system anyway or if the lock-in effect of the established closed access system will prevent such an evolutionary process. A the natural follow-up from our contest perspective would be how different researchers self-select to different contracts, and how those who "architecture" the contest would try to attract the best publications.

4.1.2 Academic Copyright in the States Game: An International Perspective

Introduction

Our previous analysis shows that there may be countervailing effects of moving towards an open access regime in publishing academic works. In this respect, especially the consequences of a shift towards the "author pays" model needs to be investigated in more detail. Shavell (2010) circumvents the consequences for authors of having to bear the publication costs by simply assuming that universities and grantors would have a motive to subsidize publication costs in the absence of copyright. This may be true for the best universities and especially for universities located in the US. However, especially for middle- and low-class universities and

[22]Note that the reputation of an author, e.g. his position in a ranking, may be a signal of quality. With other words, it is not far fetched to believe that well-renowned researchers attract a higher readership as compared to a hardly known (young) academic.

[23]We integrate type-specific readership into the social welfare function by introducing a parameter that is $h(l)$ when reading a high-type (low-type) article, where $h = 1 > l$ expresses the higher benefit from reading an article from an author with high reputation. See Feess and Scheufen (2013) for a detailed discussion.

[24]In a follow-up paper, we drop the rent-seeking motive and hence the contest character. Instead we consider a non-strategic model of quality provision. In doing so we follow Shavell (2010) as closely as possible, but introduce quality and also depart from the assumptions that all universities will cover the publication costs under OA. We then find that quality incentives are always too low for both types under closed access. Interestingly, however, quality incentives for the low type would be even lower with OA, while the ranking depends on the royalties earned under closed access for the high type. A preliminary conclusion of this paper is that OA may be more beneficial for articles, whereas a closed access regime may be superior for textbooks. See Feess and Scheufen (2014) for a discussion.

eventually for universities outside the US, an OA regime would likely increase asymmetries between universities and countries, respectively. This aspect may particularly gain recognition in the light of developing countries.

This chapter seeks to briefly address the consequences of an "author pays" model by focussing on the international perspective—especially accounting for the differences in funding research between least developed countries and the developed world. Extending on our previous model, we will first describe the effects in a very simplified model, stressing to possible distortion effects between authors when shifting towards an OA mode. However, we refrain from doing a complex welfare analysis. Instead, we will investigate the consequences of a distortion between authors by means of a simple simulation, comparing different systems in a global science community. In this regard, especially the (funding) situation of researchers situated in a low or least developed country will be addressed.

The remainder is organized as follows. First, we will shows the basic model. We then derive the privately optimal quality efforts for the two regimes. We continue by comparing the effects of a shift towards the "author pays" model in the two country case. We conclude with some important policy implications that follow from our analysis.

The Model

Extending on the model in Feess and Scheufen (2013), we assume that the quality of an academic paper depends on effort and type and is simply $q_i = \theta_i e_i$, where $\frac{\partial q_i}{\partial \theta_i} > 0$ and $\frac{\partial q_i}{\partial e_i} > 0$.[25] We consider two regimes $k = C, O$ denoting closed and open access, respectively. By g_i^k, we include an index that captures the degree to which submission fees are borne by the author i, where $g_i^O \geqq 0$ and $g_i^C \equiv 0$. With r^k we implicitly account for readership, which is $r^O > 1$ for open access and normalized to *1* for closed access. Let ε measure the readership advantage of OA, such that $\varepsilon = r^O - 1$.[26] The utility of author i in regime k is

$$V_i^k(e_i, \theta_i) = \left(r^k - g_i\right)\theta_i e_i - e_i \tag{4.11}$$

which will be maximized with respect to e and θ.

[25] Note that θ is now endogenous, i.e. author i can choose the level of θ. This differs from the model in Feess and Scheufen (2013), where θ is given by nature and distinguishes the good from the bad type researcher. Obviously, arguing that talent may be directly chosen sounds a bit awkward. However, at least indirectly this may be the case.

[26] Obviously $\varepsilon = 0$ for closed access, since $\varepsilon = r^C - 1 = 1 - 1 = 0$.

Privately Optimal Effort Levels

Taking the first order conditions and solving for the equilibrium yields

$$e_i^* = \frac{\left(r^k - g_i\right)\theta_i - 1}{\left(r^k - g_i\right)} \tag{4.12}$$

$$\theta_i^* = \frac{\left(r^k - g_i\right)e_i + 1}{\left(r^k - g_i\right)} \tag{4.13}$$

Recalling that $g_i^O \geqq 0 \equiv g_i^C$ and $r^O > 1 \equiv r^C$, we get the results as summarized in Proposition 5.

Proposition 5 *(i) The private effort incentives are increasing in readership and decreasing in the submission fee, that is,* $\frac{\partial e_i^k}{\partial r^k} > 0$, $\frac{\partial e_i^k}{\partial g_i} < 0 \; \forall i, \forall k$. *(ii) The capability variable is increasing in the submission fee and decreasing in readership, that is,* $\frac{\partial \theta_i^k}{\partial r^k} < 0$, $\frac{\partial \theta_i^k}{\partial g_i} > 0 \; \forall i, \forall k$. *(iii) Both variables do not only depend on* g_i *and* r^k*, but also on one another.*

All proofs are provided in the Appendix.

Part (i) highlights the general trade-off when shifting towards an OA regime. Whether an OA or a CA model will more likely increase researchers' incentives will depend on whether the increase in readership is able to outweigh the burden of having to bear the publication costs. Accordingly, an OA regime will only be superior as compared to a CA regime if and only if $\Delta r^O - g_i = r^O - 1 - g_i > 0$. *Part (ii)* stresses that the extend to which high (low) qualified authors may react to a shift towards an "author pays" model.[27] *Part (iii)* is obviously true, as the marginal effort level is always higher for high qualified authors and vice versa. Most interestingly, there may be different impacts on the incentives to publish if we let g vary between authors. Accordingly, the Lemmas 2 and 3 further investigate under which circumstances we will observe a distortion between authors and how this may affect the social welfare assessment of the OA regime.

Lemma 2 *For closed access, there is no distortion between authors.*

[27] Of course, one may argue that the productivity level may not be chosen endogenously by the author, but that it is rather exogenously given by nature. Nevertheless, one may also find arguments for the very opposite if we assume that the disposition of the group of researchers regarding θ may decisively be determined by means of labor market characteristics. Thus, it is the researcher's decision whether to enter the academic labor market that chooses whether high or low qualified researchers are present. If we believe in this argument, both parameters r^k and g may drive the decision making of our high (low) qualified author whether to become an academic or not. As a result, the level of θ may at least indirectly depend on the market characteristics and hence on r^k and g.

Obviously, as the readers pay for the publication costs under CA, authors do not face any other costs but their own effort in writing an article of high quality. Thus, only the productivity variable θ provides for a natural differentiation. Accordingly, in a closed access regime authors with higher productivity (better type) will *ceteris paribus* always derive higher utility levels. Other than that, there is no distortion between authors under the CA mode (Lemma 2).[28]

Lemma 3 *For open access, it depends on the distribution of g whether we will observe a distortion effect. (i) For* $g_i = 0 \forall i$*, there is no distortion for OA which is hence always superior due to* $r^O > 1$*. (ii) For* g_i *identical* $\forall i$*, there is still no distortion. However, the effort incentives may be smaller if* $r^O \longrightarrow 1$ *and if* g_i *is high. (iii) For different* g_i *we have a distortion within authors, since even highly qualified authors (i.e. those with high* θ*) might not submit if* g_i *is high, since the effort incentive depends on both* θ *and g.*

Most generally expressed Lemma 3 reflects on the consequences for the basic trade-off in an OA regime when publication costs are or are not fully covered by all universities. In this regard, OA may induce a distortion between authors depending on the direct cost effect that researcher will have to bear. Thus, it will depend on the distribution of g over the group of researchers $I = \{i = 1; \ldots; i = N)$ whether an OA regime will induce a distortion between authors. *Part (i)* reflects the simple case as assumed in Shavell (2010), i.e. all universities will cover the publication costs that result from shifting towards an OA regime for academic publications. In this case, there is no distortion between authors as $g_i = 0 \forall i$. As a consequence, the OA advantage amounts to the extend to which OA promises higher readership and hence to $r^O - 1 = \varepsilon > 0$. If we believe readership under an OA regime to be at least weakly higher as compared to the traditional publishing mode, OA will always be superior. In *Part (ii)* publication costs are not fully covered, but the degree to which researchers will have to bear the costs themselves is equally distributed. In this scenario, there is still no distortion between authors, since the benefit of shifting towards an OA mode is $r^O - 1 - g_i = \varepsilon - g_i \forall i$. Nevertheless, since the author will now partly bear the publication costs, the impact on researchers efforts decreases. Only if the OA readership advantage outweighs the publication cost disadvantage, efforts will be higher under OA, i.e. if and only if $\varepsilon > g_i$ OA will be superior. Finally, we do observe a distortion between authors if the publication costs are not equally distributed between authors and hence if some universities (at least partly) cover the costs for their researchers, while others do not (*Part(iii)*). Here, some authors will refuse to exceed higher efforts under OA if $g_i > \varepsilon$. Since authors incentives depend on both θ and g, also highly qualified authors may refuse to submit their paper. Clearly a worse case scenario from a social welfare point of view. To see the consequences especially in the international research arena, we will now turn to a simple two country comparison.

[28] Similarly, Feess and Scheufen (2013) find that effort levels are the same under CA.

		DC	
		Open Access	Closed Access
IC	Open Access	$\varepsilon / -g+\varepsilon$	$\varepsilon / 0$
	Closed Access	$0 / -g+\varepsilon$	$0 / 0$

Fig. 4.1 Distortion effects between countries: Scenario 1

Simulation: The Effect of the "Author Pays" Model in a Heterogeneous World

In a truly heterogeneous world, a shift towards an OA publishing mode may likely result in a distortion between authors. Most importantly, this may be an issue between researchers of countries at different stages of economic development. Especially since some countries may not be able or willing to provide funding for each journal publication. A simple simulation model may shed some light on the effect on researcher's incentives located in different countries and choosing between the OA and CA regime.

Suppose that the utility of an author i of country j in regime k is $V_{ij}^{k}(e,\theta) = \left(r^{k} - g_{j}\right)\theta_{ij}e_{i} - e_{i}$, where the home country status of author i decisively regulates the portion of submission fees born by herself. Further assume a two country and two author case, say one researcher from a developed or industrialized (IC) country and one from a developing country (DC). While the researcher from the industrialized country receives a full waiver for the publication fees of her paper submission, the researcher in the developing country has to bear part of the submission costs herself. As a result, assume that $g_{IC}^{O} = g^{C} = 0$ and $g_{DC}^{O} = g^{O} > 0$. Also recall that $r^{O} = 1 + \varepsilon > r^{C} = 1$, where ε denotes the readership advantage of the OA mode. For simplicity and without loss of generality we normalize θ and e to 1. The incentives scheme is summarized in Fig. 4.1.

Obviously, with only some states paying for the publications of their university researchers, a situation results where OA is only increasing researchers' incentives to the extend of the difference between the positive impact of a higher readership under the OA regime, and the negative effects on those authors who will not receive sufficient financial resources. In the two country case this induces an environment that can be best described as follows: The researcher living in an industrialized country (IC) will benefit from OA by the full readership effect. Under the veil of ignorance she would choose an OA mode since $\varepsilon > 0$. In contrast, the researcher from the developing country (DC) will only gain net benefits if the readership advantage outweighs her costs for publishing and hence if and only if $g > \varepsilon$. Taking into account that most developing countries will unlikely have the financial means to cover any of these costs, researcher from these countries would prefer to publish their papers in CA journals, since $0 > \varepsilon - g$ for $g > \varepsilon$.

Now suppose that the two countries do not only differ with respect to g. Recalling the assumption in Feess and Scheufen (2013) that the best researchers will be employed by the best universities and that mediocre universities will most likely

		DC	
		Open Access	Closed Access
IC	Open Access	$\varepsilon\theta_{IC}$ / -g+ε	$\varepsilon\theta_{IC}$ / 0
	Closed Access	θ_{IC} / -g+ε	θ_{IC} / 0

Fig. 4.2 Distortion effects between countries: Scenario 2

not fully pay the publication costs under OA, may even enhance our observation of a distortion effect between authors of different origin. We can easily find evidence for the fact that the best universities are located in the industrialized countries or especially in the US. The top 100 university ranking of 2012 lists 56 universities from the US.[29] Not a single university from a developing country is listed in the top 500. Only a few universities from emerging economies like Brazil (with 6 universities) and India (with only the Institute of Science listed in the top 400) are represented. In fact, the ranking is highly dominated by US universities, with 8 (80 %) universities from the US listed in the top 10 or 36 (72 %) in the top 50. As a consequence, assuming that θ now differs between countries and that the best researchers will tend to be located in an industrialized country—that is we assume $\theta_{IC} > 1 = \theta_{DC}$—is reasonable. This leaves us with the outcomes as summarized in Fig. 4.2.

Accordingly, the benefit of a researcher in an industrialized country is $\varepsilon\theta_{IC}$ when choosing OA, whereas OA for the DC researcher still comes along with an outcome of $\varepsilon - g < \varepsilon\theta_{IC}$. The fact that eventually only the US may be endowed with the financial means to (1) fully subsidize OA publishing and (2) attract the best researchers from all over the world may even exacerbate the dilemma in the states game. Thus, the danger of reinforcing the digital divide between industrialized and developing countries or even inducing a brain drain—even from countries like Germany or other states endowed with a more rigid budget than the US[30]—to the US shows that a shift towards a global OA regime is in need for comprehensive investigation also on distributional issues.

[29] We use the ranking published annually by the Academic Ranking of World Universities (ARWU). The ARWU is the first worldwide ranking of universities to be published. The rankings by ARWU have been conducted since 2003 and are updated on an annual basis. See http://www.shanghairanking.com/ (last accessed on September 1, 2014). For the data see ARWU (2012).

[30] To see this just assume that only researchers from the US receive a waiver on the publication costs in an OA regime. Then we would face a situation where $g_{US} = 0 < g_{others}$. Furthermore, assuming that $g_{Germany} < g_{DC}$, suggests that the distortion may differ considerably between countries outside the US. Thus, taking account of particular country parameters seems necessary when shaping an appropriate redistribution mechanism for OA funding. The development of a clear framework for such a mechanism is outside the scope of this work. However, we will sketch some basic principles to be considered in Sect. 4.2.

Policy Implications

Our analysis suggests that the biggest obstacle in shifting towards an universal OA publishing mode may be the funding scheme. Most importantly, having the author to bear the publishing costs by means of an "author fee" would likely reduce the interest for publishing research results in the lack of sufficient funding. Unless discounts are available to authors from low or least developed countries or external funding is provided to cover the publishing cost, article processing charges could exclude authors from some nations or less well-funded research fields from publishing in OA journals.

As a consequence, the two worlds (OA and CA) create a dilemma that is somewhat twofold: While OA lowers the access barriers for researchers of countries who have been hardly able to subscribe to a single journal in the past, it necessarily creates a participation constraint as it sets a price for participation in the publishing game. We have seen that OA journals do not necessarily charge author fees, but are financed by means of other income sources such as grants, print subscriptions or advertisements.[31] Moreover, many OA publishers have realized the dilemma of authors from developing countries and offer discounts or waivers to authors suffering from financial hardship. In this regard, PLoS offers a fee waiver policy that allows to waive or reduce the payment for authors from low or middle income countries. Eligible countries are distinguished in two groups[32]: Group one countries are not charged a publication fee.[33] Countries that are listed as group two members are asked a reduced fee at a flat tax of $500.[34]

Furthermore, OA still restricts access to scientific knowledge based on sufficient means of IT infrastructure. That is, online access is subject to internet access. We will see later that the poor information and technology infrastructure of countries in the developing world, especially in Sub-Saharan-Africa and rural areas, may be the most influential factor that prevents from bridging the digital divide between the developed and developing world. Accordingly, policy makers will have to account for both the participation constraint (funding of publication costs) and the access constraint (sufficient IT infrastructure) when formulating and codifying OA policies on a global scale.

[31]Recall from Sect. 3.2 that only 28.24 % of all OA journals do actually charge author fees.

[32]The fees for low or middle income countries are calculated based on the PLoS Global Participation Initiative. See their website at http://www.plos.org/about/viewpoints/global-participation-initiative/ (last accessed on September 1, 2014) for more information.

[33]For a list of eligible group one countries see http://www.plos.org/group-one-countries/ (last accessed on September 1, 2014).

[34]For a list of eligible group two countries see http://www.plos.org/group-two-countries/ (last accessed on September 1, 2014).

4.2 The Political Economy of Access to Scientific Knowledge

The implementation of OA publishing in a truly global science community and the organizational implications for academic publishing will be in need for a deep understanding and comprehensive analysis of the legal as well as politico economic transition ahead. This section will analyze the obstacles from a legal, economical and political perspective. First, we will further investigate the options and further needs for implementing OA policies in the international copyright framework. In this context, especially the role of developing countries as "leaders" for the implementation of a more flexible copyright framework and codification of soft law declaration will be highlighted. Second, the relevance and opportunities of OA publishing for developing countries and its implications from the perspective of development economics will be further investigated.

4.2.1 On the International Political Economy of Access in Science

Introduction

All of our previous analysis shows that OA may eventually provide with a better suited publishing model as compared to the traditional model, especially as it may more directly account for the needs of researchers. Nevertheless, consciousness regarding possible distortion effects within authors and also between countries will be needed in formulating an appropriate policy agenda. The legal framework for a possible reform of the academic publishing market is primarily determined by copyright law. We have seen that researchers typically transfer their copyright—or more specifically their commercial right—to the publisher when being accepted for publication. As a result, it is the copyright that enables publishers to sell journals as a bundle of academic works.

This section analyzes the options for a reform of copyright in the international arena and alternative legal origins for implementing the principles of OA in academic publishing. As we have seen, OA comes along with different costs and benefits for researchers of different countries. As a result, a broader picture on how to design the future of academic publishing is required to account for the distinguished needs and specific circumstances of developed and low or least developed countries. The remainder is organized as follows. Section "The International Copyright Law Framework" will provide a general understanding on the international legal framework. In section "Implementing OA in the International Arena" we further investigate the options for a reform of copyright and contract law. We will conclude in section "Harmonizing Copyright Law on a Global Scale" by presenting an agenda on how to proceed, clearly highlighting the need for further harmonization of international copyright law standards.

The International Copyright Law Framework

Analyzing the options for legal reform in the international copyright framework requires a general understanding on the principles of international copyright law. We have seen that copyright is territorially based. Thus, there is nothing like an international copyright law. Indeed, the relevant treaties leave it to the national legislation to install a copyright system according to the specific national needs.[35] The TRIPS Agreement and the WIPO Copyright Treaty may be rather seen as guidelines and minimum standards that national legislation shall fulfil. This sovereignty of national legislation has important implications for our later investigation on the option for copyright reform. As a result, this subsection shall recall the two basic traditions in dealing with a limiting of copyright protection. Furthermore, we will elaborate on the general applicability of the (Berne) three-step test for implementing limitations or exceptions of copyright at the international level.

Two Approaches: Continental Europe vs. US Copyright Law

As already outlined in Sect. 2.1 of Chap. 2, there are two distinct approaches for limiting copyright in scope. On the one hand, the approach in continental Europe (henceforth the European model) which has evolved on the notion of authorship, highlighting that the rights of personhood and moral rights shall dominate policy making for copyrightable works. On the other hand, the US approach (henceforth the US model) which has been driven by the utilitarian notion of copyright. Thus, copyright design follows a balancing of the costs and benefits associated with any use. As a consequence, two distinguished systems or traditions of copyright build the framework for limiting copyright in scope and hence for introducing an OA exception in the predominant national copyright laws.[36]

The European model manages copyright limitations by means of a list of enumerated exceptions or a closed catalogue. With other words: the copyright laws in Europe explicitly list a number of exceptions where the user may circumvent the principle of authorization. But at the same time this approach formulates the understanding that all other activities not covered in this list are usually proscribed (Reichman and Okediji 2012, p. 1376). These codified exceptions are updated on a regular basis as new technologies change the environmental conditions and possible uses of copyright material. Moreover, courts have tended to interpret these closed catalogues narrowly (Geiger 2010b, pp. 519 et seq.).

[35] In this regard, Art.1 of the TRIPS Agreement specifies that "members shall be free to determine the appropriate method of implementing the provisions of this Agreement within their own legal system and practice" (TRIPS 1994, Art. 1.1).

[36] A detailed comparison of both approaches is offered in Seltzer (1976) and Förster (2008).

The US model, in contrast, combines the rigid catalogue model with a broad and flexible "fair use" doctrine (sections 106–122 U.S.C.). Similarly, the English copyright law allows for the principle of "fair dealing". Following the utilitarian notion, the "fair use" principle allows a flexible balancing of the benefits and costs connected with a particular use of copyright material. Recalling the reasoning of Fig. 2.1 in Chap. 2, any use is considered to be fair and hence non-infringing as long as its benefits are able to outweigh its costs. The four statutory factors under section 107 U.S.C.—(1) the purpose and character of the use, (2) the nature of the copyrighted work, (3) the amount and substantiality of the portion used and (4) the effect of the use upon the potential market for or the value of the copyrighted work—assist in measuring the respective costs and benefits.

As a consequence, when investigating the opportunities for implementing the OA principle in domestic legislation, an understanding of the differences between the systems (civil law versus common law countries) as well as between national copyright laws is important. Despite these still prevalent differences, the (partial) harmonization of international laws by means of treaties (TRIPS, WIPO Copyright Treaty) has induced a melding of the two approaches. Most important in this harmonization process was the introduction of the (Berne) three-step test.

International Law: The Three-Step Test and Beyond

The first and most important platform for copyright harmonization throughout the twentieth century has been the Berne Convention. Established in 1886, several revisions and reforms (Paris 1896, Berlin 1908, Berne 1914, Rome 1928, Brussels 1948, Stockholm 1967 and Paris 1971) have since supplied with the primary harmonization platform, also for the implementation of limitations and exceptions in the signatory countries. For instance, the revision of 1948 in Brussels introduced an exception "for excerpts from literary and artistic works in educational or scientific publications" in Article 10(2) of the convention (Reichman and Okediji 2012, p. 1378). However, a more general term for the regulation of the limitations or exceptions in the national copyright laws was not implemented until the revision of Stockholm in 1967.

The Stockholm Revision Conference in 1967 formally incorporated an exclusive reproduction right into Article 9(1) and simultaneously subjected it to a three-step test under Article 9(2) (Reichman and Okediji 2012, p. 1379). The text of Article 9(2) says that "it shall be a matter for legislation in the countries of the Union to permit the reproduction of such works in certain special cases, provided that such reproduction does not conflict with a normal exploitation of the work and does not unreasonably prejudice the legitimate interests of the author" (*Berne Convention*, Article 9(2)).[37] Thus, the test puts forward three steps that need to be fulfilled for

[37]Ricketson and Ginsburg (2006) note that Article 9(2) was primarily intended to govern the use of academic works for research purposes. In fact, the general clause under Article 9(2) was also

limitations on exclusive rights. First, the exclusive right of the copyright owner may only be limited in certain special cases. Second, a use may be legitimate if it does not conflict with the normal exploitation of the work. Third, the use shall not unreasonably prejudice the legitimate interests of the author. In the years after the Stockholm conference the three-step test has been transplanted to other international treaties. Nowadays, the test appears also in the Agreement on Trade Related Aspects of Intellectual Property Rights (Article 13), the WIPO Copyright Treaty (Article 10) and the WIPO Performances and Phonograms Treaty (Article) (Schonwetter 2007; Reichman and Okediji 2012, pp. 1389 et seq.; Senftleben 2006, pp. 411 et seq.; Kur 2009, pp. 302 et seq.). The wording of the provisions experienced slight modifications compared to the original Berne three-step test. Accordingly, the text of Article 13 of the TRIPS Agreement states that "members shall confine limitations or exceptions to exclusive rights to certain special cases which do not conflict with the normal exploitation of the work and do not unreasonably prejudice the legitimate interests of the right holder" (*TRIPS Agreement*, Article 13).[38] The wording almost reads the same compared to the original, however, referring in its last part to the interests of the right holder, not the author. Despite the incorporation of the test in all relevant international IP treaties, there is still considerable uncertainty as to the actual meaning of the test. In practice, only one court case exists that may guide our interpretation and application of the three steps as laid forward under Article 13 of TRIPS.[39]

A promising road in interpreting the three-step test more openly and also more in the light of a "more economic approach" is a recent proposal from the Max Planck Institute for Intellectual Property and Competition Law in Munich (published in Geiger et al. 2008). In a nutshell, the proposal emphasizes the need for a more nuanced balancing between interests of authors and the broader public. In doing so, Geiger et al. (2008) follow the lines of the preamble of the WIPO Copyright Treaty, particularly mentioning education, research and access to information. In particular, the proposal highlights six issues for the future applicability of the three-step test: First, the three steps should be considered as a whole in a comprehensive and overall assessment. There should be no prioritization of any one step or the need for an affirmative answer to all steps. Instead the test should forward a "judicial balancing" of the different factors in the tradition of the US fair use approach

intended to replace the express reference under Article 10(2) that was included in the draft prior to the Stockholm Act (Ricketson and Ginsburg 2006, p. 782; Reichman and Okediji 2012, p. 1379). Nowadays, the exception under Article 10(2) is limited to only teaching purposes.

[38]The TRIPS agreement also incorporates similar statements for trademarks (Article 17), industrial designs (Article 26.2) and patents (Article 30). See section 3 in Kur (2009) for a comparison of the wording of the different provisions.

[39]See the case *WT/DS160*, available at http://www.wto.org/French/news_f/news00_f/1234db.pdf (last accessed on September 1, 2014). See also Oliver (2002).

(Reichman and Okediji 2012, p. 1454).[40] Second, limitations and exceptions should not be interpreted narrowly, but their objectives and purposes should explicitly be taken into account. Third, the criterion to restrict limitations and restrictions to certain special cases should allow (a) policy makers to also implement open ended limitations and exceptions as long as its scope is reasonable foreseeable or (b) courts to apply existing statutory limitations and exceptions or add further some where possible in the legal system (Geiger et al. 2008, p. 121). Fourth, the test should seek to foster competition, especially in secondary markets (Reichman and Okediji 2012, p. 1455). Fifth, in applying the test both the interests of the original and subsequent rightholders should enter the assessment. Sixth and most interestingly from our viewpoint, also the interests of third parties should be considered in the application of the test, including (a) interests stemming from human rights and fundamental freedoms, (b) interests in competition and (c) other public interests, with a particular emphasis on scientific progress as well as cultural, social and economic development (Geiger et al. 2008, p. 121; Reichman and Okediji 2012, p. 1454). Especially the last aspect will need particular emphasis when implementing OA in the international arena.

Implementing OA in the International Arena

In the following we will discuss two basic approaches for implementing the OA principles in the international arena. In particular, we find options for promoting the OA principles by a reform of (1) copyright and (2) contract law. In the end, both strategies may complement one another and hence forward an argument in favor of a mixed approach for the future of OA in the scholarly publishing market.

By Legislation

One option to promote open access publishing and to foster an enduring evolutionary process towards a better balancing between the interests of authors, publishers and the society as a whole is by means of a change in legislation. In this regard, we will concentrate on reforms of two promising legislative branches: First, the ability for implementing the OA principles by means of the introduction of limitations and exceptions in the international copyright system. In doing so, we will elaborate on the previously discussed three-step test, its interpretation and the openness of the balancing test as discussed by several legal scholars (Reichman and Okediji 2012; Hugenholtz and Okediji 2008; Ginsburg 2001; Geiger 2007, 2010b; Senftleben 2006; Geiger et al. 2008). Second, we will also discuss possible reforms for

[40]Fiscor (2002) highlights that the tradition of the Berne Convention actually prohibits an application of the fair-use approach. See also supra note 460 in Reichman and Okediji (2012) for a discussion.

the prevailing licensing models in the international arena. We will see that the current licensing models show significant weaknesses in satisfying the multiple requirements in a purely global science community. In the end, we will discuss the arguments for and against the proposal by Metzger (2012) to apply a "lex mercatoria" approach.

Reform of Copyright

By discussing adjustments of the international copyright framework to accommodate the needs of science,[41] Reichman and Okediji (2012) highlight two important arguments which may provide hope for overcoming the previously discussed rigidity of the international legal framework: First, both the TRIPS Agreement as well as the WIPO Copyright Treaty contain specific deference provisions that deliberately leave room to maneuver and to adjust the law according to the national needs and policy (Reichman and Okediji 2012, p. 1452). In particular, Art. 1.1 of TRIPS explicitly highlights that the "members shall be free to determine the appropriate method of implementing the provisions of this Agreement within their own legal systems and practice" (TRIPS 1994, *Art. 1.1*). Also Art. 14(1) of the WIPO Copyright Treaty stresses that its members "undertake to adopt, in accordance with their legal systems, the measures necessary to ensure the application of this treaty" (*WIPO Copyright Treaty, Art. 14(1)*).[42] Second, the flexibility built into TRIPS and the WIPO Copyright Treaty provide with means to not only strengthen copyright, but also to limit its scope by introducing new limitations and exceptions along with other balancing features (Reichman and Okediji 2012, p. 1452). Okediji (2007) emphasizes that the TRIPS Agreement eventually sets—for the first time in the history of copyright—important limits on the scope of copyright protection. Both aspects make us confident to believe that the implementation of OA in the international arena should be feasible. Nevertheless, primarily two steps shall be necessary for a more flexible framework.

First and foremost, a reinterpretation of the three-step test beyond its prevailing narrow character is probably the most important obstacle towards limiting the scope of copyright in favor of an OA culture in academic publishing (Reichman

[41]Reichman and Okediji (2012) discuss several legislative steps to accommodate the needs of science. Their proposals cover recommendations such as a tailor-made exemption for scientific research, a deliberalisation of the DRM measurements as well as a reform of database protection laws. Despite the equal importance of these aspects for adapting the legal framework to the various needs of science, a broad discussion of all issues involved is beyond the scope of this thesis. Accordingly, we will focus on changes in the copyright law that more specifically serve the promotion of OA publishing. For further reading see besides Reichman and Okediji (2012) also Peukert (2013a,b). In Chap. 5 we will further elaborate on the pros and cons of different OA policies. For now we will more generally assess the openness of the international legal framework and the steps needed to further adapt legislation for the promotion of OA on a global scale.

[42]In a recent decision, the WTO has highlighted the importance of the deference provision under Art. 1.1 of the TRIPS Agreement. See the panel report WT/DS362/R in WTO (2009).

and Okediji 2012, p. 1453). Nevertheless, there may already be evidence that the existing legal framework may exhibit flexibility features. Senftleben (2010) believes that the three-step test already sets forth open-ended factors and hence allows for the flexibility needed, without undermining the ability of national legislation to implement general exceptions for scientific and educational purposes. In particular, he stresses that "the cultural innovation cycle supported by copyright law requires both rights [freedom and protection] to be broad enough to spur investment and creativity, and limitations broad enough to provide sufficient breathing space" (Senftleben 2010, p. 526). Several recent decisions by German courts on the three-step test as codified under Art. 10 of the WIPO Copyright Treaty eventually show the space for a more liberal construction of such limitations, explicitly taking into account constitutional arguments (Geller 2010; Reichman and Okediji 2012, p. 1376). A WTO panel report from 2000 states the view of the USA that "Article 10 of the WIPO Copyright Treaty [...] reflects the standard set forth in Article 13 of the TRIPS Agreement" (WTO 2000, 6.67, p. 25). This makes us confident to believe that a more flexible application of the three-step test—more in the light of Art. 10 WIPO Copyright Treaty—should be feasible. Nevertheless, the fact that EU copyright legislation has been ignoring the opportunities for a more flexible assessment still shows the path dependence in adapting copyright law to the challenges of the digital environment.[43]

A promising road in this regard seems the declaration by the Max Planck Institute as outlined before, providing guidance for judges applying the three-step test.[44] The implementation of the six features on the agenda seems not that far from being realistic. Especially the sixth proposal—broadening the view of the three-step test to also include the interests of the general public, and not just the interests of the right holder as codified in the third step of the test under Art. 13 of the TRIPS Agreement—seems to not only explicitly consider the economic rationale of copyright as outlined in Sect. 2.1, it also goes along with prevailing legal interpretations for limiting the scope of intellectual property rights. As a matter of fact, a similar extension has already been implemented with regard to patents.[45] Here, Art. 30 of the TRIPS Agreement extends the three-step test to patent law while adding the phrase "taking account of the legitimate interests of third parties" (Reichman and Okediji 2012, p. 1454). The declaration of the Max Planck Institute takes up on this fact, stressing that the absence of such a phrase in the "copyright

[43] A critical assessment of the prevailing legal uncertainty (Netherlands) and inflexibility (France) in the European system is provided by Senftleben (2010). He concludes that "the present regulation of copyright limitations in the EC offers neither legal certainty nor sufficient flexibility. The adaptation of EC copyright law to the digital environment has led to a legislative framework that employs the open-ended three-step test to erode the legal certainty following from precisely defined exceptions instead of using the test as a means for providing sufficient flexibility" (Senftleben 2010, p. 69).

[44] See Geiger et al. (2008) for the declaration.

[45] Note that the three-step test was similarly recodified also for trademark law (*TRIPS Agreement*, Art. 17). See Senftleben (2006).

test" does not detract from the necessity of explicitly taking account of such interests. In contrast, the signatories of the declaration emphasize that it "indicates an omission that must be addressed by the judiciary" (Geiger et al. 2008, p. 119). Also in this vein can be seen the proposal by Senftleben (2010) to establish an EC fair-use doctrine on the basis of the three-step as codified under Art. 5(5) of the EC Copyright Directive. In particular, Senftleben (2010) proposes a reinterpretation of the three-step test by means of a "refined proportionality test" that allows for enough space for unauthorized use within reasonable limitations.[46] In conclusion, only a more flexible approach—especially in the EU copyright jurisprudence—for adjusting the scope and hence the limitations and exceptions to copyright law will allow policy makers to foster OA publishing in the international arena.[47]

Second, Reichman and Okediji (2012) emphasize the role of developing countries for leveraging the objectives as layed down in the WIPO Development Agenda. At its heart the 45 recommendations of the agenda stress the goal of bridging the knowledge and technology gap between industrialized and developing countries (Hugenholtz and Okediji 2008, p. 8). In this regard, the drafted treaty on "Access to Knowledge" (A2K) may be a sufficient orientation on how to reach the goal to "protect and enhance [expand] access to knowledge, and to facilitate the transfer of technology to developing countries" (*A2K Treaty*, Art. 1–1).[48] As outlined before, the draft treaty emerged throughout the efforts of Brazil and Argentina and was primarily intended to ease the transfer of knowledge to the developing world (Opderbeck 2007, pp. 113 et seq.). During a series of meetings in 2005 a draft treaty was prepared by representatives from developing countries as well as representatives from the UK and the US, including a catalogue of exceptions to copyright that essentially mirror the "fair use" or "fair dealing" concepts. In particular, the "A2K" treaty would generally limit copyright law akin to existing compulsory licensing provisions (Opderbeck 2007, p. 115; Helberger 2005). Furthermore, the "A2K" draft treaty includes sections on the limitation of digital right management (DRM) systems (article 3-6), copyright term extension (article 3-9) and compulsory licensing of copyrighted works in developing countries (article 3-12). Part 5 of the draft treaty further specifies ways for "expanding and enhancing the knowledge commons". Accordingly, any work "resulting from government-funded research shall be publicly available at no charge within a reasonable time frame, subject to reasonable exceptions, for example, for classified military research, for patentable discoveries, and for works that generate revenue for the author, such as

[46] See also Senftleben (2004). Besides, see Geiger et al. (2008) for an application of the three-step test under this premise.

[47] We will discuss the pros and cons of various policies which aim at fostering the evolution of an OA mode in academic publishing in Chap. 5. In this context, specific references on how to incorporate these aspects into the international legal framework will be made, reverting to the lessons made here.

[48] See http://www.eifl.net/access-knowledge-a2k (last accessed on September 1, 2014) for the A2K treaty.

books" (article 5.2(a)). In addition, a knowledge commons committee (KCC) shall "promote cooperation and investment in databases, open access journals and other open knowledge projects that expand the knowledge commons" (article 5-1). Within two meetings in February and June 2006, finally, the committee chair proposed to move forward on proposals that had received consensus support. This proposal was rejected by the developing countries that claimed significant IPR reforms. In fact, the proposal followed primarily the interests of the US and the European states which were considered as a back-room maneuver by developing countries (Opderbeck 2007, pp. 116 et seq.).

For the future reform process and success in reaching the objectives of the WIPO Development Agenda, several scholars have been pointing to the special role of developing countries for claiming more flexible measurements. Reichman (2009) argues that developing countries should rather lead than follow in the process of reform, triggering a codification of users' rights at the international level or at least a soft-law instrument to be adopted at WIPO (Reichman and Okediji 2012, p. 1457).[49] Hugenholtz and Okediji (2008) argue that "a joint initiative between WIPO and the WTO could be an ideal and appropriate expression of a soft-law modality with real impact for collective action on an international instrument on L&E's" (Hugenholtz and Okediji 2008, p. 49). For instance, Hugenholtz and Okediji (2008) point to the "Joint Recommendation Concerning Provisions on the Protection of Marks and Other Industrial Property Rights in Signs, on the Internet" and the "Joint Recommendation Concerning Provisions on the Protection of Well-Known Marks", both adopted by the Assembly of the Paris Union for the Protection of Industrial Property and the General Assembly of the WIPO.[50] Despite the fact that neither of these provisions are binding, especially the latter has been evolving towards an international standard as it has been incorporated in several bilateral agreements by the US (Hugenholtz and Okediji 2008). In this regard, the draft of the A2K treaty may provide a useful pattern in developing a similar provision concerning copyrights. Last but not least, Hugenholtz and Okediji (2008) point to the special role of the "Standing Committee on Copyright and Related Rights" (SSCR) to contribute to developing coherence in the international copyright framework. Working towards a coordination between SSCR and the TRIPS council would likely foster a harmonization process in the international copyright arena and could eventually forward an instrumental framework for reaching collective action despite the sovereignty of national states.

In conclusion, both a recodification of the international three-step test (in accordance to the US fair-use principles) in combination with a reform process

[49]Reichman and Okediji (2012) stress that steps towards an implementation of such a soft-law instrument by regional groups such as Latin American or African countries could help to accelerate a broader movement for a deliberalisation of the international copyright framework. Reichman and Okediji (2012) also highlight that Brazil has started to implement a provision on "transformative and incidental uses". See Helfer et al. (2009) and Armstrong et al. (2010) on similar steps in South America and Africa, respectively.

[50]See WIPO (1999, 2001) for the panel reports.

that incorporates the needs of developing countries (by incorporating users' rights provisions at the international level) is decisive for adjusting the international copyright framework to accommodate particular OA principles for academic publishing. Nevertheless, the promotion of an OA mode in academic publishing will not be effective by copyright reform alone. In fact, a reform of the available licensing models but also contractual deliberations may be required.

Reform of Licensing Models

Even within the copyright system as a "all rights reserved" regime, alternative modes have been developed which offer legal tools or instruments for a self-enforcement of a "some rights reserved" regime. These instruments use the general licensing options as codified under the law.[51] In this regard, most OA journals but also self-archiving platforms revert to the so-called Creative Commence licenses. We have seen that the "Public Library of Science" (PLoS) and BioMed Central as the leading OA publishers, for example, apply the so-called Creative Commons Attribution License (CCAL). The CCAL allows authors to retain their copyright, but allows anyone to download, reuse, reprint, modify, distribute and/or copy articles from the respective journal. Springer Open Choice,[52] as a commercial publisher, uses the Creative Commons Attribution Non-Commercial License, which allows readers to read, copy and distribute a work and to create derivative works for non-commercial purposes. In general, the CC licenses offer a means to specify certain usage rights. In doing so the CC scheme operates on the basis of four general licensing elements, whose combination form a scheme of six different licenses. Figure 4.3 summarizes the six licensing models (red frame) as well as the basic license elements (black frame) as offered by CC.

Accordingly, there are four general licensing elements that form six different licenses on three levels. The most basic license on the first level is the CC Attribution License (CC BY). With this license the right holder lets others distribute, remix, tweak and build upon her work, even commercially, as long as attribution to the original creator is guaranteed. This "attribution" element also forms the basic element for all combinations on the second and third level in the licensing scheme. As a result, on the second level three licensing schemes can be distinguished that constitute combinations of the attribution element with each of the three other terms. First, the Attribution-No Derivative Works (CC BY ND) licence which allows others to distribute the work, even commercially, as long as the work is unchanged and attribution to the original creator is guaranteed. Second, the

[51] As seen before there are two forms of transfer of copyright: (1) Copyright Assignment and (2) Copyright Licensing. We concentrate on the latter, as an assignment of copyright would involve a transfer of (all) rights in an exclusive and definite manner. Thus, this approach does not comply with the "droit d'auteur" principle and does not account for attribution as the most relevant aspect for scientific researchers.

[52] See the website of Springer at http://www.springer.com/open+access/open+choice?SGWID=0-40359-0-0-0 (last accessed on September 1, 2014).

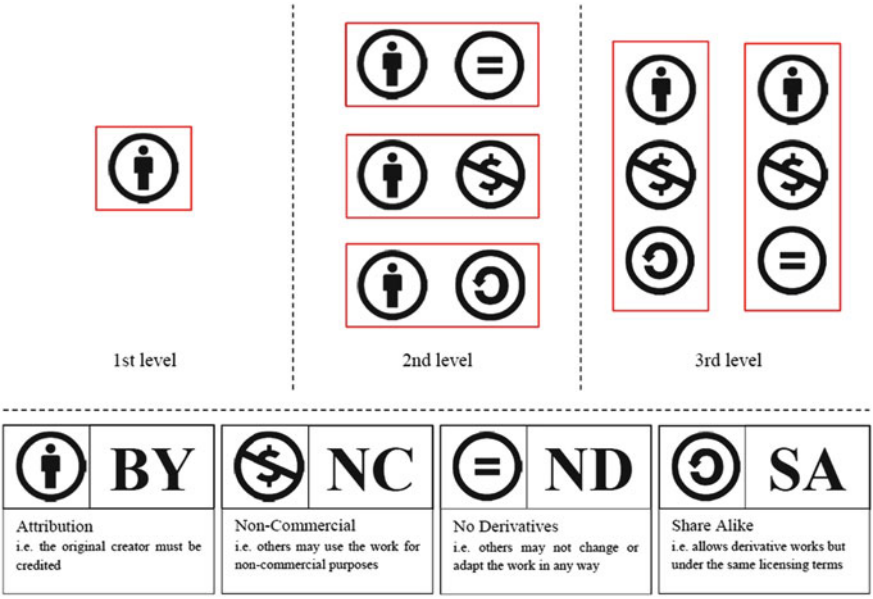

Fig. 4.3 The creative commons licensing scheme

Attribution-Noncommercial (CC BY NC) licence allows others to distribute, remix and build upon the work only if the use is not intended to follow any commercial purpose and if the original creator is credited. Third, the Attribution-Share Alike (CC BY SA) licence lets others use—i.e. distribute, remix and build upon—the work even for commercial purposes as long as the credit of attribution to the original author is assured and the resulting new works are shared under the same licensing terms. With other words, this license allows to share the material as long as new works are also shared in return. The third level, finally, depicts combinations of three of the basic terms, always accounting for attribution as the basic element. As a consequence, two licenses can be distinguished. The Attribution-Noncommercial-Share Alike (CC BY NC SA) licence allows any non-commercial use of the work subject to attribution and the sharing of new works under the very same terms. The Attribution-Noncommercial-No-Derivatives (CC BY NC ND) licence instead allows any non-commercial use of the work as long as the original creator is credited and the original work is not adapted or changed in any way. As a matter of fact, a licence cannot feature both the Share-Alike and No-Derivatives terms as the Share Alike requirement applies only to derivative works.[53]

A special feature of the CC model is that it eventually seeks compliance with the international copyright framework. In particular, CC International has been working

[53]For more information see the website of CC at www.creativecommons.org/licenses (last accessed on September 1, 2014).

on an international license porting project since 2003, seeking to port CC licenses to different copyright legislations around the world (Maracke 2010, p. 6). In the porting process the original license is basically modified to reflect local nuances in two respects, the legal terms and the language. That is, the licensing terms are translated into the respective local language(s) and adapted to the legal culture to reach compliance with the national legal requirements. CC International offers guidelines for this process by means of a detailed ten-step program, explaining in detail how to proceed from the forming of a porting team to the final launch of the national version of the licenses.[54] By now, more than 70 jurisdictions offer ported national versions of the CC licenses. Among the first countries to adapt the CC licensing terms to national requirements were Brazil, Germany and the Netherlands in 2004. All ported licensing schemes are upgraded on a regular basis, currently available in version 3.0. Version 4.0 is currently in preparation.

Despite the wide spread of ported licensing versions, several problems remain that are mainly concerned with issues of internationalization and the constraints that the principle of territoriality imposes on the applicable choice of law. In this regard, some ported licensing version even comprise a "choice of law clause" that refers to the law of the given jurisdiction. This is e.g. the case for the latest licensing versions in Austria, England, Germany, Romania, Switzerland and Wales. However, the licensing versions of France, Netherlands, Poland and Spain do not comprise such a choice of law clause (Metzger 2012, supranote 35).[55] Elkin-Koren (2006) highlights the problems associated with the territoriality of CC licensing for managing licensed content on a global scale, emphasizing that "the lack of standardization in the licenses supported by this licensing scheme, further increase the cost of determining the duties and privileges related to any specific work. This could further increase the chilling effect of copyrights" (Elkin-Koren 2006, p. 17).[56] Metzger (2012) frames the legal difficulties associated with ported licenses by means of a simple illustration: "A is a historian at the university of Bucharest. He has created a database of Jewish cemeteries in Central and East Europe consisting of some hundred entries with maps, photographs and descriptions in different languages. A wants to share the database with other interested researchers in Romania and abroad. After visiting www.creativecommons.org, he chooses the Creative Commons Attribution-ShareAlike Version 3 Romania. The license text is in the Romanian language. According to Section 8 lit. f) Romanian law is applicable. B from Berlin finds the database on the Internet. He makes a number of important entries on cemeteries in Germany and wants to make this modified version available on his private website. Unfortunately, B does not read Romanian. In this case, B would be worse off as compared to the use of the 'unported' license version because he would have to translate the license terms before reading them. It could even

[54] See the CC website at http://wiki.creativecommons.org/International_Overview (last accessed on September 1, 2014) for a detailed overview on the ten-steps for porting the CC licenses.

[55] See Rosenkranz (2011) on the problems of choice of law clauses in CC licenses.

[56] Similarly see Woods (2009).

be that under German contract law, standard terms in languages which may not be expected to be understandable for contracting parties may be unenforceable, especially in the case of consumers" (Metzger 2012, p. 364). As any use via the internet tends to cross borders, ported licenses may impose extremely high costs and legal uncertainty (Maracke 2010, p. 12). CC takes the prevailing problems with ported licenses explicitly into account in the process of launching version 4.0. In this regard, the list of objectives and goals includes internationalization, seeking to "further adapt the core suite of international licenses to operate globally, ensuring they are robust, enforceable and easily adopted worldwide."[57]

A strategy to avoid the various problems associated with national licensing versions and comprising a choice of law clause is to provide unported licenses. CC does provide such unported licenses which may be used for jurisdictions that do not offer a ported licensing version (Metzger 2012, p. 364). The idea behind unported licenses is to ease the global management of creative content by means of just one generic license text for worldwide use. In doing so, unported licenses refer to internationally accepted terminology as codified under the respective IP conventions. Accordingly, the legal code of the CC-BY 3.0 unported license, for instance, specifies under section 8 f. that the "rights granted under, and the subject matter referenced, in this License were drafted utilizing the terminology of the Berne Convention for the Protection of Literary and Artistic Works (as amended on September 28, 1979), the Rome Convention of 1961, the WIPO Copyright Treaty of 1996, the WIPO Performances and Phonograms Treaty of 1996 and the Universal Copyright Convention (as revised on July 24, 1971). These rights and subject matter take effect in the relevant jurisdiction in which the License terms are sought to be enforced according to the corresponding provisions of the implementation of those treaty provisions in the applicable national law" (*CC*, Art, 8 f.).[58] Nevertheless, also unported licenses may come along with drawbacks, especially when having to decide which law to apply in front of the court. When licensor and licensee belong to different jurisdictions, we may be left with very similar problems as before. As a consequence, this shows an important reference to the previously raised arguments for a reform of copyright at the international level.

A workable solution for these problems has recently been provided by Metzger (2012) and can be somehow seen in the tradition of the previously discussed soft law declaration. Metzger (2012) argues that unported licenses should not be governed by national laws, but should follow a lex mercatoria approach. The basic idea behind the lex mercatoria theory is that throughout the history of international trade a body of internationally customary rules has evolved that effectively regulates trade independent from any specific national law. The old lex mercatoria basically consisted of unwritten law that was applied by the medieval courts of admiralty

[57]See the CC wiki at https://wiki.creativecommons.org/4.0 (last accessed on September 1, 2014) for a general overview on CC version 4.0.

[58]For the legal code see the CC website at http://creativecommons.org/licenses/by/3.0/legalcode (last accessed on September 1, 2014).

(Metzger 2012, p. 365).[59] The modern lex mercatoria instead refers to a set of model rules such as the "UNIDROIT Principles for International Commercial Contracts"[60] to govern international commercial transactions (Marrella and Yoo 2007, pp. 817 et seq.).[61] Especially in this las characteristic of lex mercatoria—the international contractual practice—Metzger (2012) sees the required theoretical link between lex mercatoria and open source/access communities.[62] Most importantly, such a lex mercatoria licensing system would provide a neutral terminology in the licenses beyond any choice of law clause or need for an application of national law. By contrast, the licensing terms would be based on the community structure. Universal rules and norms that follow the mechanisms and customs of academic publishing. Lex mercatoria licensing models would offer general principles comparable with standard contracts in the lex mercatoria debate. In this regard, the UNIDROIT principles could serve as fall back provisions (Metzger 2012; Marrella and Yoo 2007).

The applicability of the lex mercatoria approach for OA may hence depend on the question whether there are such customs or norms within the community of researchers. We may find guidance in the history of academic publishing. We have seen that copyright did not play a vital role in the relationship between publishers and authors before commercial publishers entered the academic publishing market in the 1960s and 1970s. In fact, the relationship between academic journals and copyright was merely occasional, as academic journals were primarily published by learned societies and academic institutions (Ramello 2010, p. 13).[63] Consequently, there must have been a body of immanent rules that governed publisher/author transactions. Looking more closely at the community of researchers does in fact reveal a high level of social homogeneity. We have learned that researchers primarily publish their works for "reputation building claims" and for the purpose of reaching a socialization within their peer-community. Beyond this immanent reward structure, a mechanism of scientific communication by means of academic journals has evolved that has become standard. Furthermore, the overall process from writing the work, to the peer-review for quality selection and typesetting tasks is enforced by the community itself. These rules are not just social norms, they are enforced in practice and create the standard setting for measuring performance of academics worldwide. Here, it will be the task of academic association and scientific institutions to self-

[59] On the medieval lex mercatoria see e.g. Donahue (2004).

[60] See the UNIDROIT website at http://www.unidroit.org/english/principles/contracts/main.htm (last accessed on September 1, 2014) for further information. See also Berger (1996) on the lex mercatoria doctrine and the UNIDROIT Principles of International Commercial Contracts.

[61] The modern lex mercatoria approach was primarily influenced by Goldman (1964). A further development of this approach is Goldman (1979, 1986).

[62] Note that the arguments similarly apply to other open innovation communities, such as the open source software (OSS) community. On OSS as the new lex mercatoria see Marrella and Yoo (2007). On the analogy between the OSS and the OA movement see Scheufen (2011) and Willinsky (2005).

[63] See Sect. 3.1 for a review of the history of academic journal publishing.

enforce these principles. Recalling the lessons from the history of academic journal publishing—with the tradition that academic associations published the works of their researchers—may be a good guidance for the future policy agenda.[64]

Nevertheless, Metzger (2012) clearly highlights the limits of the lex mercatoria approach as a framework for managing OA licensing on a global scale. Most importantly, the application of a lex mercatoria approach will be limited to cases where the parties are actually free in choosing the applicable law. Copyright issues of the licensing contracts—especially features such as scope and hence limitations and exceptions to copyright protection—will not be subject to lex mercatoria. Especially in this context, reforms for a deliberalisation of the international copyright framework—as previously discussed—will be necessary to complement a workable licensing scheme beyond the perspectives outlined here.

By Contract

A complementary approach to a reform of copyright is to contractually regulate the access, use and reuse of academic journal content. In particular, governments and nonprofit agencies who largely fund scientific research, especially in the OECD countries, could impose an OA mandate on researchers who received funding for their research results. With other words, researchers would be mandated to arrange for free and unrestricted access to their funded research outcomes as a condition to their funding contract(s). Here, both governments and funding agencies can force such contractual conditions. Governments can dedicate government funded works to the public domain (Reichman and Okediji 2012, p. 1469; Reichman and Uhlir 2003, p. 318). Such a mandate is for example enforced by US copyright, where 17 U.S.C. §105 denies copyright protection for works that are produced by government employees within the scope of their employment. But also funding agencies have the ability to condition receipt of funding sources on OA requirements.[65] Such a mandate could require funded researchers to either deposit pre- or post print versions of their works in OA repositories or to submit their works to purely[66] OA journals.[67]

[64]We will further elaborate on the opportunities and requirements of academic associations in Chap. 5.

[65]Reichman and Okediji (2012) also point to options for imposing analogs to fair use and other codified limitations by contract.

[66]Pure OA journals are journals that follow the definition by the BOAI (2002). Pure OA journals are listed by the DOAJ. See the website at http://www.doaj.org/ (last accessed on September 1, 2014). See also Sect. 3.2 for a review.

[67]We will focus on the first. Obviously, mandates that require publication with gold OA are not very reasonable as long as OA journals still lack considerably in terms of reputation as compared to established CA journals. The impact factor advantage of CA journals would in fact induce just another distortion between authors with and without commitment to publish in OA journals only. Moreover, Suber (2012) stresses the low number of OA journals, constituting only 25 % of all peer-reviewed journals.

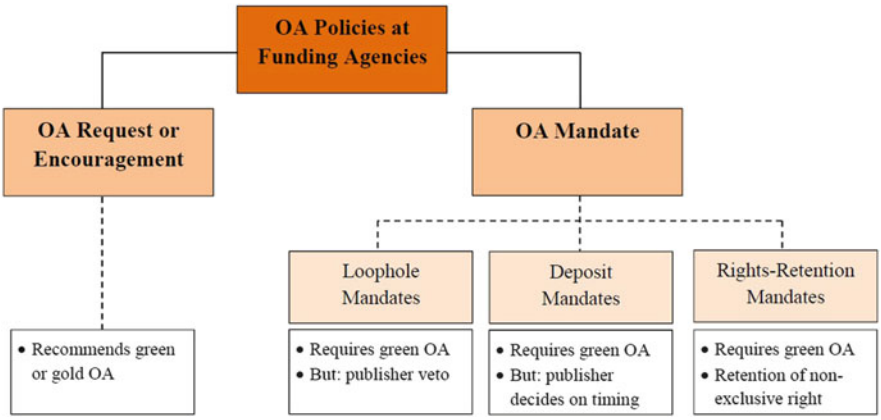

Fig. 4.4 OA policies at funding agencies (extending on Suber 2012, pp. 77 et seq.)

In general, three types of "pure"[68] OA mandates can be distinguished (Suber 2012, pp. 77 et seq.). First, loophole mandates. This form of OA mandate requires self-archiving of papers that do not conflict with the journal publishers' copyright agreement. With other words, if a journal publisher explicitly bans authors from depositing their work in an OA repository, authors can use these loopholes to escape the mandate. Second, deposit mandates. Here, self-archiving is required as soon as the paper is accepted for publication. However, deposit mandates separate the timing of deposit from the timing of OA (Suber 2012, p. 79). In particular, the timing of OA depends on publisher's permission and hence whether the publisher allows for a self-archiving after a certain period of time. As a result, also with this form of mandate a deposited work may remain non-OA. Third, rights-retention mandates. Just like deposit mandates the rights-retention mandates require self-archiving as soon as the paper is accepted for publication. However, the funding agency may require to retain the nonexclusive right to authorize OA throughout self-archiving platforms (Suber 2012, p. 80).[69] Figure 4.4 summarizes the different categories of mandates, leaving us with a reference for further discussion in Chap. 5.

As we have seen, there are several examples for the practice of OA mandates by funding agencies. The most recent developments show that even large funding agencies such as the RCUK and the NIH have changed their OA policies to require a deposit of published papers in OA repositories. Most attention has lately been directed to the developments in the UK. Since 2012, a strong OA policy in the UK requires that RCUK funded research is published by means of OA after an embargo

[68]OA mandates typically use words like "must" or "shall" and hence require or seem to require OA. In contrast to a mandate, request or encouragement policies merely ask or recommend to their members to publish OA (Suber 2012, p. 78).

[69]We will see later that a copyright exception by means of a so-called "inalienable right of secondary publication" may offer a similar tool to ensure rights-retention mandates.

period of 12 months by providing either OA to the post-print version (including all changes from peer-review) via the journal's website or depositing a final version of the paper in other repositories. In this regard, the committee explicitly emphasizes the need for international coordination and suggests that the UK government should "act as a proponent for change on the international stage and lead by example" (SCST 2004, p. 97). The large increase in OA mandates by funding agencies (and universities) during the last years shows the importance that has been given to OA. Nevertheless, prevailing loopholes and less rigid OA policies show that there is a large gray area of literature that finds ways to escape from the OA requirement. The consequences in the form of distortions between authors of different institutions (and countries) and hence varying OA policies are obvious.

A complementary approach to OA mandates may be to give authors more bargaining weight in the contractual relationship with journal publishers. As a consequence, a promising strategy for the promotion of OA publishing may be a mixed strategy that combines OA mandates by funding agencies with a legal reform that prevents from loopholes due to clauses in journal publishers' copyright agreements. We have seen that a central subject-matter of publishing contracts is the transfer of an exclusive commercial right to the publisher. That is, if not otherwise stated in the contract an author may loose her right for secondary publication, including the right to deposit a final version of the paper in an OA repository. A study by Gadd et al. (2003) analyzes 80 journal publishers' copyright agreements with a particular view on the ability of authors to self-archive. The study finds that 90 % of the publishers asked for some form of copyright transfer, where even 69 % asked for a transfer of copyright prior to refereeing the paper. Only 42.5 % allowed self-archiving in some format. An updated overview on publishers' copyright policies relating to self-archiving is the website of SHERPA/RoMEO.[70] The website includes policy facts for currently 1,275 publishers. The statistical facts reveal that 70 % of these publishers allow for some form of self-archiving, with 62 % allowing both pre- and post-print self-archiving and only 8 % banning authors from depositing a post-print version of their final paper. For instance, the American Economic Review is considered as a "green journal",[71] explicitly stating that authors can archive both pre-print (i.e. pre refereeing) and post-print (i.e. the final draft post-refereeing) versions, whereas the archiving status for the publisher's version (i.e. pdf with final typesetting) is stated as unknown. This shows that, even though publishers do typically allow for some form of self-archiving, it is them to decide whether an OA mandate may be binding for authors or not. However, changes in legislation may provide with a sufficient condition to allow authors to

[70] See the website at http://www.sherpa.ac.uk/romeo/ (last accessed on September 1, 2014).

[71] SHERPA/RoMEO classifies publishers in four categories according to their self-archiving policy: (1) "green", i.e. authors can archive pre- and post-print; (2) "blue", i.e. authors can archive post-print; (3) yellow, i.e. authors can archive pre-print; (4) white, i.e. archiving is not formally supported. See the website of SHERPA/RoMEO at http://www.sherpa.ac.uk/romeo/statistics.php?la=en&fIDnum=|&mode=simple (last accessed on September 1, 2014) for more information.

self-archive their works in any case. In the US, the general copyright exception for governmental works under §105 is an example for such a condition. Also in Europe similar provisions seem under way.[72] In Germany, only recently the government introduced a bill for a reform of §38 UrhG, covering not only the implementation of an inalienable authors right for secondary publication, but also issues related to the orphan works problem.[73] The bill shall provide the author of an academic work with the right to re-use her publication for non-commercial purposes after an embargo period of 12 months after publication. In particular, the new bill shall enable the researcher to deposit a copy of her publication on a repository. On 3 May 2013, the German Federal Council (Bundesrat) even strengthened the position of academic authors by recommending a reduction of the embargo period from 12 months to only 6 months after publication.[74]

In conclusion, both OA mandates by funding agencies complemented by sufficient copyright exceptions that give the author more bargaining power against the journal publisher may enhance the international spread of OA publishing. Nevertheless, also here international coordination between funding agencies and national copyright legislations seems required. In fact, the RCUK Open Access policy may be a useful model for other funding agencies around the globe. Most importantly, however, funding agencies will have to guarantee to provide for the publishing costs of OA publishing by means of sufficient grants. In this regard, international coordination will be necessary to prevent from the negative distortions as revealed by our analysis.

Harmonizing Copyright Law on a Global Scale

All of the above leaves us with a crucial message for the future policy framework in the organization of academic publishing: For reaching collective action between states, further progress in the harmonization process of the international copyright framework is necessary. In this process, three important steps will most likely foster the spread and success of OA publishing on a global scale.

First and foremost, our analysis of the international copyright framework—especially with respect to the Berne three-step test—clearly reveals the rigidity of the current system. A promising road for the recodification process of the three-step test is the Max Planck declaration. Most importantly, the future framework will

[72] Bitton (2012) analyzes the implementation of the "Public Sector Information" (PSI) directive by the EU member states.

[73] For the bill see RegE (2013).

[74] See Bundesratsbeschluss (2013). Note that on 27 June 2013 the German Bundestag enacted an inalienable right of secondary publication for academic works, not considering the recommendations of the Bundesrat. See http://open-access.net/de/austausch/news/news/anzeige/bundestag_beschliesst_open/ (last accessed on September 1, 2014) for more information. See Pampel (2013) for a comment. We will further elaborate on the inalienable right of secondary publication in Chap. 5.

have to allow for more flexibility in adjusting the scope and hence the limitations and exceptions to copyright law to accommodate the needs of science. In this context, the proposal by Senftleben (2010) to foster a reinterpretation of the three-step test by means of a "refined proportionality test" that allows for enough space for unauthorised use within reasonable limitations may provide a good starting point for the reform process. A first reasonable step in this reformation process would be a signal of openness by the EU copyright jurisprudence. A copyright reform fostering OA publishing in the international science community will only be possible if the standards for setting the scope of copyright law converge from a conflicting "two approach model" towards a more flexible approach that accounts for elements of "fair use" also in EU legislation.[75]

Second, developing countries will have a special role in claiming more flexible measurements and leveraging the objectives of the WIPO Development Agenda. We have seen that with the drafted "A2K" treaty it already exists a sufficient orientation to enhance access to scientific knowledge and facilitate the transfer of ICT infrastructure to developing countries. Developing countries should rather lead than follow in this movement. In fact, the developing world should have a strong incentive to force a strong exemption for scientific research in keeping with the WIPO Development Agenda (Reichman and Okediji 2012, p. 1441).

Third, also large funding agencies like the National Institutes of Health (NIH), the Welcome Trust or the Research Councils UK (RCUK) should take a lead in mandating OA publishing for all publicly funded research. In Sect. 3.2 we have seen that there have been several steps of funding agencies to demand the deposit of publicly funded research in institutional or subject-based repositories. In coordinating the efforts of funding agencies and other associations but also for reaching commitment on the international level, there have been several initiatives like the Budapest Open Access Initiative (2002), the "Bethesda Statement on Open Access Publishing" (2003) and the "Berlin Declaration on OA to Knowledge in the Sciences and Humanities" (2003). Follow up conferences should be directed towards including more institutions and agencies. Most importantly, creating awareness of OA publishing and overcoming prevailing prejudices (such as low quality of OA journals) will have to be on the agenda for the future. Last but not least, solutions for the funding dilemma of institutions in developing countries will have to be developed. Obviously, a truly transnational funding entity for the coordination (and redistribution) of funds between institutions and countries would be a possible starting point for reaching coordination and avoiding possible distortions that our analysis has pointed to. Examples for such transnational coordination entities are numerous in other fields like banking (the World Bank) and international trade (WTO). An orientation could be found in the context of another global public good problem that induces different costs and benefits to different regions/countries of the world: climate change. In this regard, scholars and policy makers have been pointing to the "Clean Development Mechanism" (CDM) that does not only account

[75] See Senftleben (2010) on an EC fair use doctrine.

for the costs of climate change that primarily occur in countries of Sub-Saharan Africa, but also includes a mechanism of technology transfer to these countries. In the context of "scientific knowledge" as a global public good we have pointed to a similar aspect, highlighting that policy makers will have to account for both the participation constraint (funding of publication costs) and the access constraint (sufficient IT infrastructure) when formulating and codifying OA policies on a global scale.[76] That is, an analogy to "climate change" and the CDM could be a starting point for discussing steps towards the implementation and funding of OA publishing in the international arena.

4.2.2 *On the Role of Open Access in Developing Countries: A Natural Experiment*[77]

Introduction

Several authors have been highlighting the positive effects that an OA regime for academic publishing would induce especially for developing countries who have hardly been able to subscribe to a single journal in the past (Suber and Arunachalam 2005).[78] The new OA movement has been arousing hope for overcoming the still prevalent digital divide between developed and developing countries. As a matter of fact, the technological revolution ushered in by the internet and the vast increase in opportunities in the digital environment may have provided with the chance to involve all nations in science and technology. Obviously, advances in science, medicine, technology and agriculture have the potential to contribute to a reduction in poverty and diseases around the globe (Annan 2004). The picture on OA in developing countries, meanwhile, is somewhat two fold: First, OA

[76] See Hackl and Pruckner (2001) for further reading.

[77] This subsection serves as a draft for a spin-off and joint research project with Frank Mueller-Langer from the Max Planck Institute for Intellectual Property and Competition Law in Munich. The written words and the analysis are solely my work. However, in the labor-intensive process of data collection I enjoyed support by Frank Mueller-Langer and his student assistant Jonas Jungbauer. Parts of the empirical analysis evolved in joint discussions with Frank Mueller-Langer. Moreover, I am highly thankful for valuable comments from Patrick Andreoli-Versbach, Joel Waldfogel, Ruth Towse and Stan Liebowitz as well as the conference participants at the annual congress of the Society of Economic Research on Copyright Issues (SERCI) on 9 and 10 July 2013 in Washington DC, USA.

[78] Obviously, we have seen that an OA publishing mode may also have a downside, especially when considering the publishing costs which have to be born by the author. Nevertheless, our analytical setting is not influenced by this potential threat to the participation constraint as the journals under the Research4Life regime do not raise any author fees. By contrast, most of the journals are actually "closed access". The publishers instead commit to provide with an open or reduced fee access to their journals. As a result, these journals provide a perfect setting as they are freely accessible (benefit of OA) but without charging authors for publication (cost of OA).

increases the ability for local researchers in developing countries to generally access scientific publications. Second, researchers in these countries may be enabled to actively contribute to the literature and hence the advancement of science. However, especially with respect to the latter aspect we have seen that a comprehensive redistribution mechanism in an universal OA mode would be necessary to ensure participation of researcher from the developing world.

Facilitating open access in developing countries requires both promotion of OA journals and publishing as well as an adequate "Information Communication Technology" (ICT) infrastructure (Christian 2008, p. 10; Ahmed 2007). Some first steps towards an open access to scientific publishing for developing countries have been made in areas relevant to health, agriculture and environment. First, the "Health InterNetwork Access to Research Initiative" (HINARI) launched by the "World Health Organization" (WHO) and six major publishers in the area of health in 2002 provides currently access to more than 12,700 journals.[79] Other initiatives like the "Access to Global Online Research in Agriculture" (AGORA) and "Online Access to Research in the Environment" (OARE) provide with similar services regarding the areas of agriculture and environment, respectively. While first success stories have been reported just recently, a comprehensive survey still remains unacknowledged. Besides, these OA initiatives only provide free online access to their journals to the poorest countries, allowing for free or reduced fee access to countries according to their "Gross National Income" (GNI) per capita. As such, countries like India, South Africa, Chile etc. are not members as their incomes disqualify them from participating in either initiative.[80]

Our paper seeks to analyze the role of OA in developing countries by means of a natural experiment. In particular, the impact of the OARE initiative will be analyzed.[81] Three main groups or areas of countries including Sub-Saharan Africa, Latin America and a control group—will create a setting for a natural experiment, where differences in GNI per capita and in the level of ICTs will qualify to provide with considerable evidence on the role of OA and the barriers to a change in the developing world.

The remainder of the paper is organized as follows: Section "Research4Life Initiatives" gives an overview on the "Research4Life" programmes and outlines recent developments. In section "Literature Review", we will give a short literature review and explain to what extend our research is different to existing studies. Some descriptive statistics and first insights on data and methodology is provided

[79]See the website of HINARI at http://www.who.int/hinari/en/ (last accessed on September 1, 2014) for more information.

[80]In fact, the participating publishers themselves may decide who is eligible or not. Several scholars in this respect argue that emerging markets like India and China may have been excluded from such OA initiatives as these countries account for a significant part in the subscriber portfolio of publishers.

[81]Please note that the collected data allows for an analysis of all "Research4Life"-initiatives. Nevertheless, we focus our investigation on the OARE initiative as there is no research available so far and as a coverage of all four initiatives would be beyond the scope of this thesis.

in section "Data and Methodology". Section "Empirical Findings" discusses the empirical findings of the effect of the OARE initiative on the ability of researchers in developing countries to participate in the global science community. We conclude in section "Limitations and Proceedings", highlighting the limitations of our empirical investigation and the proceedings of our research.

Research4Life Initiatives

An Overview

Among the various OA initiatives in developing countries,[82] especially three initiatives namely HINARI, AGORA and OARE—that are part of the broader programme of "Research4Life"[83] have been most influential in the OA movement in Africa and other developing countries. In particular, the programme provides free or low-cost online access to academic and professional peer-reviewed journal content to eligible countries in the developing world. In the following, we will first provide a detailed background on the history and the content of all three initiatives that are part of the "Research4Life" programme.

HINARI

In January 2002 the "World Health Organization" (WHO) and six major publishers[84] launched the "Health InterNetwork Access to Research Initiative" (HINARI). The initiative provides free or low-cost access to peer-reviewed journals containing particularly biomedical and health information, where access is provided subject to registration of public institutions[85] in developing countries and according to a country's GNI per capita. While HINARI offers a free online access to the journals of participating publishers for institutions in countries with a GNI per capita below $1,600 (Band 1 countries), institutions in countries with a GNI per capita between $1,601 and 4,700 (Band 2 countries) receive access to the full range of OA journals by paying a fixed fee of $1,000 per year and institution.[86] When HINARI went

[82] See Ahmed (2007) on page 349 for an overview on OA initiatives in Africa.

[83] See their website at http://www.research4life.org (last accessed on September 1, 2014) for more information.

[84] Among them were Blackwell, Elsevier Science, the Harcourt Worldwide STM Group, Wolters Kluwer International Health & Science, Springer Verlag and John Wiley.

[85] Eligible institutions are national universities, research institutes, professional schools (medicine, nursing, pharmacy, public health, dentistry), teaching hospitals, government offices and national medical libraries. Access is provided to staff as well as students of these institutions. See http://www.who.int/hinari/eligibility/en/index.html (last accessed on September 1, 2014).

[86] The data is obtained from World Bank figures and can be accessed via the HINARI website at http://www.who.int/hinari/eligibility/en/index.html (last accessed on September 1, 2014).

online in January 2002, the six major publishers in the area of health provided access to around 1,500 journals. Since that time the number of participating publishers and journals has been steadily increasing. In present, about 150 publishing partners provide with access to more than 12,700 journals. In total, 4,800 institutions in 105 countries have registered to HINARI, with 63 Band 1 (free access) and 42 Band 2 (low-cost access) countries.[87] However, not all developing countries are eligible to join the HINARI initiative. Here India, China and Chile abound as examples for emerging countries that are currently excluded by the publishers.

AGORA

The Access to Global Online Research on Agriculture (AGORA) initiative was initiated by the Food and Agricultural Organization (FAO) of the United Nations and nine founding publishers[88] in October 2003. AGORA provides with free or low-cost access to peer-reviewed journals in agriculture and related biological, environmental and social sciences to public institutions in developing countries.[89] In accordance with the rules in the HINARI initiative, AGORA also distinguishes between Band 1 (free access) and Band 2 countries (low-cost access). The division is hereby based on the Gross National Product (GNP) per capita (World Bank figures). As such, institutions in countries with a GNP per caipta below $1,600 are eligible for free online access. Institutions with a GNP per capita between $1,601 and 4,700 are eligible to receive access to AGORA by paying a fee of $1,000 per year and institution. Since the launch in October 2003, the number of participating publishers has been steadily increasing from 9 to 82 with access to 400 (3,000) journals in 2003 (2013). In total, 107 countries have registered to AGORA by July 2013, with 65 Band 1 (free access) and 42 Band 2 (low-cost access) countries.[90]

OARE

In October 2006, the "United Nations' Environment Programme" (UNEP) and the Yale University launched the "Online Access to Research in the Environment"

[87]The only country eligible for registration with HINARI that did not register is North Korea. The core of Band 1 countries is geographically located in Sub-Saharan Africa. Among the countries with the most registered institutions (more than 100) are primarily countries located in Latin America (Venezuela, Columbia and Peru) and Sub-Saharan Africa (Sudan, Ethiopia, Uganda, Kenya, Tanzania, Nigeria and Ghana).

[88]Among them are Blackwell Publishing, CABI Publishing, Elsevier, Kluwer Academic Publishing, Lippincott, Williams & Wilkins, Nature Publishing Group, Oxford University Press, Springer Verlag and John Wiley & Sons.

[89]See the AGORA website at http://www.aginternetwork.org/en/about_agora/ (last accessed on September 1, 2014). Eligible institutions are universities and colleges, research institutes, agricultural extension centres, government offices and libraries.

[90]As is the case with HINARI, the core of Band 1 countries are geographically located in Sub-Saharan Africa.

(OARE) initiative.[91] OARE provides access to more than 4,150 journals in the area of environmental research following the same format as HINARI and AGORA. Since its launch the programme has steadily been able to attract new partners. Currently there are more than 350 OARE partners who provide access to their journal content to public institutions and non-governmental organizations in eligible countries.[92] In this context, institutions in countries with a GNI per capita below $1,250 are eligible for free access (Band 1). Institutions in countries with a GNI per capita between $1,250 and 3,500 receive access to OARE content by paying an annual fee of $1,000 per institution. In total, OARE provides access to their journal content to currently 107 eligible countries, with 65 Band 1 (free access) and 42 Band 2 (low-cost access) countries.

Recent Developments

A key aspect of the open access initiatives in developing countries is not only to provide access to journal content to staff and students in research institutions and non-governmental organizations, but also to facilitate and promote open access by online training and national workshops. In particular, all partners of the Research4Life initiative have committed to provide with appropriate long-term training on the use of the services. Several training modules have been worked out by partners of the programme and field-tested by librarians and information managers in 16 developing countries. These training modules have been available online and on CD-ROM. The material can be used by librarians or researchers individually or in groups.[93] In addition, national workshops have been conducted. Such workshops have been held in Asia, Latin America, Europe and Africa. The workshops follow a so-called "Train the Trainer" approach and are conducted to train librarians, information specialists, scientists, researchers and students. Courses include presentations, lectures, group discussions, product demonstrations and hands-on practices. The course material is forwarded in terms of handouts which are available in five languages.

In (Sub-Saharan) Africa several workshops in 32 different countries have been held. In total, 550 health, agriculture and information specialists have been trained so far. In the context of Africa, the workshops are carried out by the Information

[91] See their website at http://www.oaresciences.org/ (last accessed on September 1, 2014) for more information.

[92] Eligible institutions and non-governmental organizations are for example universities and colleges, professional training schools, research institutes, government ministries and other governmental offices, libraries, public media and local NGOs. See http://www.oaresciences.org/eligibility/en/index.html (last accessed on September 1, 2014).

[93] See the website of "Research4Life" at http://www.research4life.org/about.html (last accessed on September 1, 2014) for more information.

Training and Outreach Centre for Africa (ITOC).[94] As such, the next workshop is planned at the University of Namibia from November 11 until November 15, 2013.[95]

Only recently, the WIPO together with its partners in the publishing industry[96] launched an additional initiative with the "Access to Research for Development and Innovation" (ARDI)[97] initiative. Starting in 2009 and joining "Research4Life" on August 23, 2011, this initiative has been providing free online access to scholarly literature that is critical to innovation processes. The ARDI initiative primarily aims at achieving two goals: (1) developing countries shall be enabled to participate in the global knowledge economy; (2) researchers in developing countries shall be supported in creating and developing new solutions to technical challenges faced on a local and global level.[98] Currently, the ARDI initiative includes 17 publishers who provide with access to nearly 10,000 journals from diverse fields of science and technology. As of July 2013, 107 eligible countries have registered to the ARDI programme. However, due to the short time horizon since its launch, the ARDI programme will not be included in our research project.

Empirical Analysis: On the Role of OA in Developing Countries

Literature Review

The usage of HINARI, AGORA and OARE has been steadily increasing since their start. All partners committed to support the programmes until at least 2015. Nevertheless, a comprehensive study addressing the chances and challenges of open access to scientific publications still remains unacknowledged. A survey published in Science by Evans and Reimer (2009a) emphasizes the need to further assess the role of open access and particularly the success of the "Research4Life" programmes in developing countries. Evans and Reimer (2009a) show that "lower-middle-income countries tend to much more frequently cite freely available journals, but the poorest do not" (Evans and Reimer 2009b, p. 5). Thus, scientists in the poorest

[94]See the website at http://www.itoca.org/ (last accessed on September 1, 2014).

[95]See the website at http://www.itoca.org/node/81 (last accessed on September 1, 2014) for an overview on upcoming trainings.

[96]In this regard, the WIPO cooperated especially with 12 major publishers in the field of development and innovation. The publishers are: American Association for the Advancement of Science, American Institute of Physics, Elsevier, Institute of Physics, John Wiley & Sons; Oxford University Press, National Academy of Sciences, Nature Publishing Group, Royal Society of Chemistry, Sage Publications, Springer Science+Business Media; Taylor & Francis. Other programme partners include the FAO, the International Association of Scientific, Technical & Medical Publishers, the United Nations Environment Programme and the WHO. See http://www.wipo.int/ardi/en/partners.html (last accessed on September 1, 2014) for more information.

[97]See their website at http://www.wipo.int/ardi/en/ (last accessed on September 1, 2014) for more information.

[98]See http://www.wipo.int/ardi/en/ (last accessed on September 1, 2014).

countries seem to have virtually no access to online journal content. The authors suggest that poor infrastructure and internet access may have explanatory power for this gap in the participation of researchers.

Furthermore, Ross (2008) provides with a comprehensive study of the HINARI and AGORA programmes by using journal-citing patterns of authors in the least-developed nations. She shows that the average percentage change to journals of the HINARI and AGORA initiatives has generally increased from 2002 to 2008, however, with high regional and sub-regional variations, especially with respect to the African countries. As such, Africa generally demonstrated "positive finding for the region, whereas all of the African sub-regions did not. While Northern, Western and Eastern Africa demonstrated positive results, Middle and Southern Africa did not" (Ross 2008, p. 88). By focussing on the HINARI programme, Ross and Buckles (2011) show for the eligible American countries that there exists a relationship between the use of HINARI journals and internet user statistics. Consequently, the most apparent barrier to the use of "OA initiatives" like HINARI, AGORA and OARE may be the slow development of the information and communication technology (ICT) infrastructure. In fact, especially in some sub-regions the poor ICT capacity may explain why there is "polarization" (Castells 2000), i.e. while the aggregated regional data shows positive results, sub-regional data does not.

Analytical Setting

The so-called digital divide, i.e. the differences in the ability to access and to contribute to scientific output between developing and developed countries, has been addressed by many scholars in the last two decades.[99] However, even among the developing countries there are considerable differences. In this context, Ahmed (2007) shows that while all countries in Sub-Saharan Africa contributed only to 0.7 % of the worldwide scientific output in 2001, India and China accumulated 1.9 and 2.0 %, respectively. He concludes that particularly the poor access to scientific publications—exacerbated by the institution of copyright—may explain these differences.[100] The "Research4Life" programmes have removed these copyright restrictions and have provided free or low-cost access to journal content to overcome this lock-in. Thus, it may be asked: Have the "Research4Life" programmes had a significant impact on the rate of participation of researchers from developing countries in the global science communication?

This paper seeks to analyze the role of open access in developing countries by means of a natural experiment. In this section, our analysis will focus on the OARE initiative by assessing its usage through citation data that is retrieved from the

[99] See Cetto (2001), Riddoch (2000), Goldenberg (1998), May (1997), and Gibbs (1995).

[100] See Ahmed (2007), p. 348.

Thomson Reuter's Web of Science database.[101] Access to the database is provided by the University of Hamburg and the Max Planck Institute for Intellectual Property and Competition Law in Munich. We use the Science Citation Index and the Social Science Citation Index for gathering article-level records with citation information. The database offers queries to isolate journal articles authored by researchers from a particular country and for a specific period of time.

Three main groups or areas of countries—including Sub-Saharan Africa (Cameroon, Congo, Ethiopia, Ghana, Kenya, Nigeria, Sudan, Tanzania, Uganda, Zambia)[102] and South America (Bolivia, Columbia, Ecuador, Peru, Venezuela)[103] and a control group (Botswana, Gabon, Malaysia)[104]—create a setting for our natural experiment, where these regions differ considerably in their (1) level of GNI per capita and hence participation in the "Research4Life" programmes, and (2) standard in information and communication technology (ICT) infrastructure.

Data and Methodology

The data was extracted in the period from July 2012 until January 2013, covering 18 countries from three country groups (Sub-Saharan Africa, Latin America, Control Group). In total 133,028 journal publications where evaluated, containing citation information on 986,591 references. The process of data preparation can be summarized in three stages: (1) data extraction, (2) data matching and (3) data evaluation. First, the data collection was carried out by extracting citation information for each single country from the Thomson Reuter's Web of Science database. In particular, the Web of Science database allows via advanced search the creation of complex queries using two-character field tags and the setting of combinations. In this regard, advanced searches via CU-tags allowed for a detailed analysis of publications from authors of particular countries.[105] The timespan was set to cover the period from January 2000 until June 2012. The extracted data included the full set of information available from Thomson Reuter's Web of

[101] Note that this draft is work in progress and is the start for a joint research project with Frank Mueller-Langer. In the proceedings of the project the scope will be broadened to include all "Research4Life" programmes. Furthermore, also the role of pure OA journals shall be analyzed. We will further elaborate on the proceedings in our section on "limitations and proceedings". The fact that this is the first research to include all programmes as well as OA journals in general, shows the innovativeness of the project as a whole.

[102] Selection criterion: More than 75 institutions registered to Research4Life.

[103] Selection criterion: More than 75 institutions registered to Research4Life.

[104] Selection criterion: At the edge of eligibility for the Research4Life initiative based on GNI per capita.

[105] For instance, inserting the query "cu=("Cameroon")" allows to search for publications from authors with affiliations to Cameroon universities.

Science, including also information on the cited references for each publication[106] as well as information on the affiliation of the authors (including full information on the names of all authors, affiliated institutions and country of origin). Second, after further editing the retrieved data files the data was matched to further assess the usage of OARE journals.[107] In this regard, the list of OARE journals as well as the list of all journals listed in the Web of Science database was matched to filter the core of journals that were contained in both lists. In executing the journal matching a "VLOOKUP"-function was created to search the lists for both journal name as well as the ISSN number.[108] The list of matched journals—i.e. the list of journals that were part of both OARE and Web of Science—was used to identify which of the cited references were attributed to OARE journals and non-OARE journals. For assessing the degree to which a publication was produced by using OARE journal content, a dummy was created taking the value 1 if the cited publication was published in an OARE journal and 0 if not. The ratio of all OARE citations in relation to all citations in a single publication yielded the degree of OARE usage. So far, the files contained article-level records. In step three, the data was aggregated for further data evaluation, picturing the relevant variables on a quarterly and yearly basis. For our analysis we will use the yearly data, giving information on average counts for each year and country.[109]

The methodology for our empirical analysis is a simple "difference-in-difference" (DiD) model.[110] The DiD-Model is generally applied for estimating a so-called treatment-effect, especially in the context of (natural) experiments. In particular, the DiD-Model compares the treated units before and after a treatment. However, to control for possible other factors that might have influenced the result

[106]Please note that Thomson Reuter's allows to retrieve only 500 full records at a time. In cases where more than 500 records were listed, the data extraction was segmented into several steps. That is, if for example 1,261 records were listed, three country files were extracted, where file one contained records 1–500, file two the records 501–1000 and file three 1001–1261. Afterwards, all record files were merged to one single country file containing the full record of publications of a country for the time from January 2000 until June 2012.

[107]Editing of the files included the creation of separate excel sheets for the evaluation of "the references" and "author affiliations". Most importantly, the raw data as retrieved from the Web of Science database arranged the information on authors and references in single fields. Accordingly, all authors were listed in a single column and each separate cited reference with information on year, journal, author etc. was also listed in one column. For a further evaluation of both citations and affiliations via the "VLOOKUP" function in excel the information on the particular journal, for instance, had to be separated in columns.

[108]Note that the ISSN number allows for a perfect matching of both journal lists, as the number is unique and hence guarantees the identification of a certain journal. However, for some journals the ISSN number was not provided. In such cases, a separate matching via the journal name allowed for an identification.

[109]See the descriptive statistics for an evaluation.

[110]In the proceedings of the research project the empirical analysis will be broadened to allow for a more elaborate assessment of this complex matter. In this regard, we will for example apply a regression discontinuity model. See our section on "limitations and proceedings" for a discussion.

	Eligible Countries	Non-Eligible Countries	Difference
Before	$\beta_0+\beta_1$	β_0	β_1
After	$\beta_0+\beta_1+\beta_2+\beta_3$	$\beta_0+\beta_2$	$\beta_1+\beta_3$
Difference	$\beta_2+\beta_3$	β_2	β_3

Fig. 4.5 The "Difference-in-Difference" model (extending on Wooldridge (2005, p. 454))

of the treatment, we typically compare the treatment group with a control group to "difference out" these factors and isolate the effect of the treatment (Imbens and Wooldridge 2009, pp. 67 et seq.; Imbens and Wooldridge 2007; Stock and Watson 2011, chapter 13). Consequently, the basic form of the DiD-Model contains observations for both treatment and control group before and after the treatment was assigned. The treatment effect is then calculated as follows:

$$Effect = \left(treatment_{after} - treatment_{before}\right) - \left(control_{after} - control_{before}\right) \quad (4.14)$$

This more general framework builds the fundament for our analysis of the OARE initiative. Looking at the citation data, the empirical model then looks as follows:

$$Cit_i = \beta_0 + \beta_1 treat_i + \beta_2 after_i + \beta_3 \left(treat_i after_i\right) + e_i, \quad (4.15)$$

where $treat_i = 1$ if the country i is eligible and 0 if the country is not eligible. $After = 1$ if after and 0 if before the launch of OARE. The coefficient of the interaction term then gives us the treatment effect. Figure 4.5 illustrates the calculus behind the estimate β_3 (following Wooldridge 2005, chapter 13).

A classical example of a DiD-model applied to analyze the impact of a policy change in two different countries is the paper by Card and Krueger (1994). The authors use the DiD-methodology to estimate the effect of a policy increasing the minimum wage in Pennsylvania on the employment at fast food restaurants. Before we discuss the results of our DiD analysis, we will have a look at the descriptive statistics.

Descriptive Statistics

From the data primarily two performance measurements were generated, picturing both the number of publications of authors from the respective country as well as the number of citations of journals that were part of the OARE initiative. Both numbers were related to the total number of publications or journals cited, respectively. Accordingly, the *relative publications* variable measures the number of publications

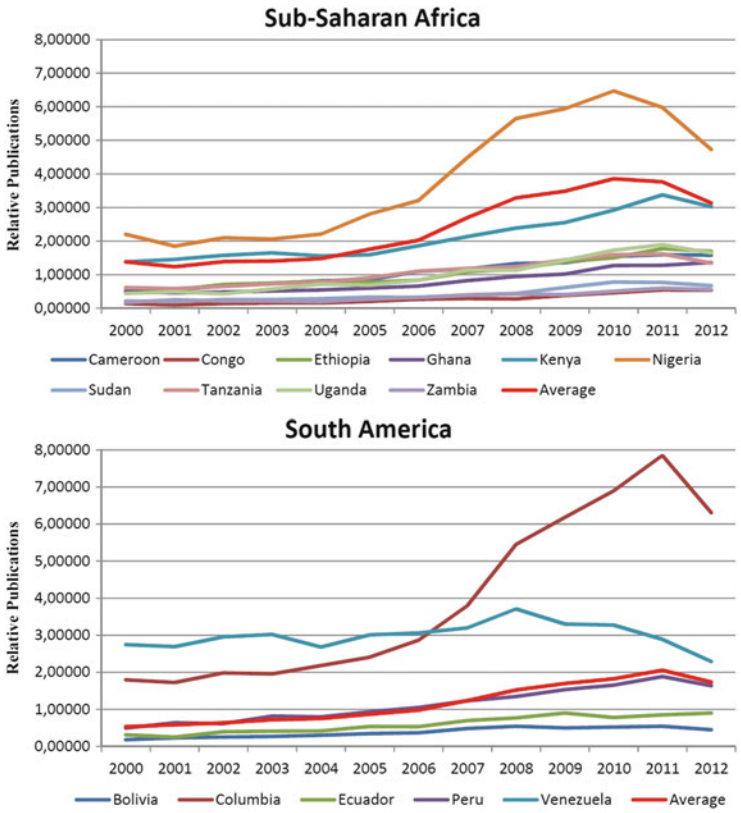

Fig. 4.6 Relative publications: Sub-Saharan Africa vs. South America

per day from authors of the reviewed country for the time from January 2000 until June 2012, controlling for both gap years[111] as well as for the year 2012, where only 182 days were observed (timeframe being 1 January 2012–2030 June 2012). The *relative citations* variable reflects the ratio between citations from OARE journals to the total amount of cited journals. Accordingly, this variable shall provide a measurement to assess the degree to which OARE fostered the creation of new research results.

With respect to the *relative publications* we observe an increase in the number of academic works for almost all countries. Figure 4.6 illustrates the development of *relative publications* in Sub-Saharan Africa and South America. The red line highlights its average development, accounting for the weighed average in the relative number of publications in both regions, where the weight incorporated a control accounting for the number of registered OARE institutions in the respective

[111] Gap years included the years 2000, 2004, 2008 and 2012.

countries.[112] Nigeria (for Sub-Saharan Africa) as well as Columbia and Venezuela (for South America) stand out as being far above average with respect to the number of publications per day. For the Sub-Saharan African countries the average development shows a vast increase in the research output especially since 2006. Before, the number of publications per day stagnated at about 1.5 publications per day. The number more than doubles for the years from 2007 until 2012, peaking in 2010 at 3.86. Even though this increase in the number of relative publications can be observed for all countries in the Sub-Saharan Africa sample, the development in Nigeria stands out. Here, the number of publications per day increased from about 2.0 for the years from 2000 until 2004 to 6.47 in 2010. For all countries the variable shows a slight decrease for the year 2012, with an average of 3.13 publications per day. For the South American countries of our sample we find similar developments. For these countries the average number of publications per day increased almost by a factor of 4 from 2000 until 2012, peaking in 2011 with 2.06 publications per day. However, the increase is rather equally distributed over the years and does not show as much momentum after 2006 as compared to the countries in Sub-Saharan Africa. Nevertheless, the development of the *relative publications* in Columbia stands out. Here, the research output exhibited a vast increase especially since 2006, where the number increased from 2.4 in 2005 to 7.85 in 2011. Again the number decreases slightly for 2012, showing 1.74 *relative publications* for the South American sample on average. Comparing both regions also shows that the average publication output for the South American sample is always below the average development for the country sample of Sub-Saharan Africa.

For the second performance measure—*relative citations*, i.e. the percentage of citations from OARE journals—the picture is not as clear cut.[113] On average, the percentage of cited OARE journals increased from 0.16 (0.20) in 2000 to 0.22 (0.27) in 2012 in Sub-Saharan Africa (South America). For the South American sample, especially the development in Bolivia stands out. Here, more than 32 % of all citations were from publications that belonged to the long list of OARE journals after the year of 2007. More importantly, the number jumps after the launch of OARE in October 2006. Also negative examples were observed with the development in Columbia. In Columbia the relative number of OARE citations decreased significantly from 0.19 in 2000 to 0.06 in 2012. Despite these examples, the development of the *relative citations* showed high fluctuations, especially in countries of the Sub-Saharan Africa sample. Figure 4.7 shows the development of *relative citations* for both Sub-Saharan Africa and South America.

Both performance measurements find evidence for an improvement of the research situation in developing countries. However, whether a better access to (some) journals by means of the OARE initiative is responsible for the development is questionable. To control for other influences besides membership to the OARE

[112] See Fig. 7.8 in the Appendix for a detailed picture, also on the number of registered institutions with OARE.

[113] See also Fig. 7.9 in the Appendix.

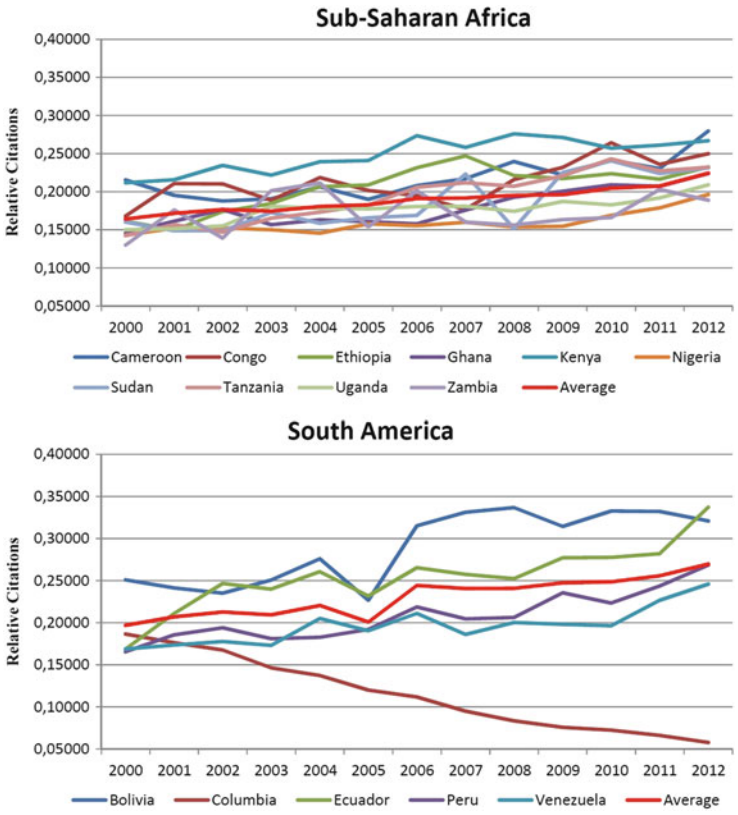

Fig. 4.7 Relative citations: Sub-Saharan Africa vs. South America

initiative, we also accounted for other control variables. Most importantly, access to journal content may have been provided throughout cooperations with authors from institutions in the developed world. Five variables consider the affiliation of co-authors with institutions in (1) OECD countries, (2) EU countries, (3) EU 15 countries, (4) countries from North America and (5) the USA.[114] In fact, the numbers reveal that for most of the countries the vast majority of academic papers

[114]In doing so, we created five dummy variables for each single publication to control for co-authors affiliated with institutions from (1) OECD countries, (2) EU countries, (3) EU 15 countries, (4) countries from North America and the (5) USA. That is, the dummy took the value 1 if at least one co-author was affiliated with such an institution, 0 if not. With other words: For publications that were referred to authors solely from developing countries, the value was 0. For all others, some form of cooperation with the developed world was found.

were co-authored.[115] With respect to cooperations with OECD countries,[116] 8 of the 10 countries (80 %) of the Sub-Saharan sample and 4 of the 5 South American countries reveal numbers that exceed 50 % and more.[117] For most of these countries even 60 or more percent of all publications were produced in cooperation with a member of an OECD country. We also find evidence for an increase of cooperations over time. For instance, OECD cooperations of academic works produced by researchers with a Cameroon affiliation increased from 62 % in 2000 to almost 73 % in 2012. Similarly, for Bolivia the percentage of OECD cooperations increased from 80 to 90 %. Most interestingly, Nigeria as the country with the vastest increase in the number of publications (see Fig. 4.6) stands out as an exception. Here, only 24.5 % of all academic papers were produced in cooperation with partners of OECD members. Furthermore, the numbers stayed at the same low level over time, reaching its maximum in 2012 with 27.1 % and a minimum of 17.5 % in 2008. Also for Colombia as the leader of the South American sample the OECD cooperations remained at a rather low level with 54.6 % (53.8 %) in 2000 (2012). Similar findings are reported for the other four controls, revealing that on average most cooperations were dominated by affiliated institutions from Europe.[118]

Other control variables relate to both economic development as well as ICT infrastructure indicators.[119] With respect to the latter we collected World Bank figures to indicate the ability to access journal content online via the internet. These indicators referred to the level of broadband infrastructure (both in total and per 100 inhabitants), internet access per 100 inhabitants, ICT servers (both in total and per million inhabitants) and telephone lines (both in total and per 100 inhabitants).[120] The level of economic development was pictured by means of both GDP per capita (both in constant and current US dollars and GDP growth in percent) as well as GNI per capita (both in constant and current US dollars and GNI growth in percent). Due to data availability two indicators (1) internet access per 100 inhabitants and (2) GDP per capita in constant US dollars are used to give an overview on both ICT infrastructure (indicator (1)) and the level of economic development (indicator

[115] See Figs. 7.10 (for Sub-Saharan Africa) and 7.11 (for South America) in the Appendix for the numbers.

[116] Please note the overlap between the control variables (1)–(5) as the EU memberstates and the USA are also members of the OECD. As the OECD reveals the broadest coverage, we will primarily report the findings for control variable (1) in this section. An overview on all numbers is given in Figs. 7.10 and 7.11 of the Appendix.

[117] Exceptions are reported in Nigeria and Uganda (both Sub-Saharan Africa) and Venezuela (South America).

[118] A comparison between both control variables (2) EU countries and (3) EU 15 shows that the majority of cooperations was driven by EU 15 memberstates.

[119] Other indicators were the number of academic journals and the number of OARE registrations.

[120] For a definition and overview of the different World Bank indicators see their website at http://data.worldbank.org/indicator (last accessed on September 1, 2014).

(2)).[121] Regarding ICT infrastructure we find significant differences between the two samples as the level of internet access is clearly higher in the South American countries as compared to the countries in the Sub-Saharan Africa sample. Over time, both samples show developments towards a better infrastructure. In Sub-Saharan Africa, for instance, internet access per 100 inhabitants increased from 0.25 in 2000 to 5.0 in 2011 for Cameroon. Again, Nigeria stands out as an exception within the group of countries of Sub-Saharan Africa. While in 2000 only 6.4 % had internet access, the number increased vastly after 2007 reaching 28.4 % in 2011. In South America, for example, internet access increased from 1.44 % in 2000 to 30 % in 2011 for Bolivia. In Venezuela and Columbia, even more than 40 % had internet access by 2011. Also the level of economic development shows large differences between as well as within the samples. Accordingly, the GDP per capita (in constant US dollars), for example, increased from 592.4 in 2000 to 665.8 in 2011 for Cameroon.[122] The South American sample showed a significantly higher level in GDP per capita. For instance, in Bolivia as the poorest country, GDP per capita (in constant US dollars) increased from 1,010.9 in 2000 to more than 1,276 in 2011.

Empirical Findings

Now we turn to the empirical findings. In doing so, we will first further specify the structure of our empirical analysis.[123] Then we will discuss the results.

Model Specifications

As described above, we use a simple DiD-model—extended by further controls—to assess the impact of OARE membership on both performance measurements, *relative publications* and *relative citations*.[124] Accordingly, we present two different assessments, where *relative publications* denotes the dependent variable in the first assessment, and *relative citations* the dependent variable in our second assessment. Formally, we use the model as stated in Eq. (4.16) extended by a vector of

[121] See Fig. 7.12 in the Appendix for an overview.

[122] Please note that Cameroon stands out as one of the "richest" countries in the Sub-Saharan Africa sample. Among the poorest countries is Congo with a GDP per capita (in constant US dollars) of 86.75 (109.81) in 2000 (2011).

[123] The summary statistics of all previously reported variables are also shown in Fig. 7.13 of the Appendix.

[124] We use a robust regression based on iteratively reweighted least squares. Stata offers this robust option via the rreg command. A similar robust regression is the so-called cluster option. In executing our empirical analysis we also used this option by clustering our regression by means of both "country number" and "country group" (Sub-Saharan Africa, South America, control group), with results similar to the results presented here.

other explanatory variables which shall account for aspects other than OARE membership.[125] This yields two models of the form

$$y_i = \beta_0 + \beta_1 OARE_i + \beta_2 After_i + \beta_3 (OARE_i After_i) + \gamma X_i' + e_i, \quad (4.16)$$

where y_i denotes the dependent variable (i.e. *relative publications* in the first assessment, *relative citations* in the second assessment), $OARE_i$ denotes membership to OARE (where $OARE_i = 1$ if country i is a member, 0 if not), $After_i$ specifies the launch of the OARE initiative (where $After_i = 1$ if after and 0 if before the launch of OARE).[126] X_i' is a vector of explanatory variables depending on the respective model specification. β_0 is the constant. γ is a vector of regression coefficients corresponding to the respective vector of explanatory variables and e_i is the error term. The coefficient of the interaction term (β_3) then gives us the treatment or OARE effect.

We use seven different model specifications to assess the role of OARE to explain the development of (1) *relative publications* and (2) *relative citations*. Here, the first specification represents the pure or simple DiD model without additional variables. In model 2–4 we add "research cooperations" as explanatory variables, where model 2 looks at *OECD* cooperations only whereas model 3 and 4 state combinations of *EU* and *North America* or *EU15* and *USA*, respectively. In model 5–7 we also include *internet (ICT)* and *GDP per capita* as additional variables, where model 5 and 6 look at combinations of *internet (ICT)* and/or *GDP per capita* with the OECD variable. Model 7, finally, is the same as model 6, including both *internet (ICT)* and *GDP per capita*, but dropping the *OECD* variable in favor of *EU* and *North America*.[127] The structure follows the same lines for both assessments (*relative publications* and *relative citations*).

Results

The regression results examining the effect of the OARE initiative and additional variables on the *relative publications*—i.e. the number of publications per day and year—are reported in Fig. 4.8. Looking at the basic DiD-model only (Model

[125] As discussed in the descriptive statistics, the controls include aspects like research cooperations with researchers from (1) OECD, (2) EU, (3) EU15, (4) North America or (5) USA as well as variables related to the level of economic development and ICT infrastructure.

[126] Please note that the OARE initiative was launched in October 2006. To account for possible timegaps in the registration process we set the start of the initiative to January 2007 (i.e. for the years 2007 and later the dummy $After_i$ takes on the value 1, before the value is 0). In the Appendix we also present an empirical analysis where we account for a longer timegap. Such an assessment may be reasonable as the time between writing and publishing an academic paper is (very) long for some disciplines. However, we will see that this does not change much for the results as presented here.

[127] Obviously, as EU memberstates as well as the USA are also members of the OECD, we have to assess their role separately from one another.

Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7
After	-.05294808	-.08902702	-.25835241	-.26132405	-.0766093	-.38120977*	-.28263214
Member	.37084607**	.26055784	.04221519	.03931424	.44039395**	.94274047***	1.1630866***
AfterMember	.45088897*	.5507092**	.73454127**	.73455373**	.05574226	.52493922**	.46788381**
OECD		-1.6023028***			-2.0320684***	-1.9921454***	
EU			-1.4580269***				-1.0593994***
Namerica			-.85453007*				-2.8697159***
EU15				-1.4541609***			
USA				-.94202482*			
Internet					.06074789***	.03258964***	.03463479***
GDP_PC_con~S						.00025153***	.00030024***
_cons	.42454321**	1.5806132***	1.6112531***	1.612764***	1.5338038***	.85700098***	.41407062*
N	234	234	234	234	212	212	212
F	10.700582	16.722937	11.784864	11.948373	66.982069	56.56989	61.71992

legend: * p<.1; ** p<.05; *** p<.01

Fig. 4.8 Relative publications: an empirical assessment

1) already suggests that membership to the OARE initiative positively affects the performance of a country. The effect is significant at the 10 % level. However, we also find a positive time trend that is significant at the 5 % level. Extending our regression by adding further (control) variables shows evidence that membership to the OARE program did in fact significantly influence the number of relative publications. Furthermore, we now find evidence that also cooperations with researchers from OECD, EU, EU15, North America and USA (models 2–4) as well as ICT infrastructure and GDP per capita (models 5–7) may play a role. Most interestingly, we find evidence that a good ICT infrastructure positively influences the likelihood to perform better in terms of *relative publications*. This finding is consistent with our intuition as sufficient internet access is a necessary prerequisite for accessing journal content online. Despite the fact that the results are highly significant (at the 1 % level), the coefficient is rather small. Looking at the level of economic development in terms of GDP per capita (in constant US dollars) suggests that the effect is marginal. Last but not least, research cooperations seem to significantly influence the performance of a country. However, we find a large negative effect, which is somewhat inconsistent with our intuition. In this regard, we would have expected that cooperations with researchers from an industrialized country positively affects the performance of a researcher in the developing world.[128]

The results examining the effect of the OARE initiative and additional variables on the *relative citations*—i.e. the percentage of citations from OARE journals—are reported in Fig. 4.9. Here, we find no evidence for an impact of an OARE membership on the performance of a country. By contrast, allowing for additional variables such as research cooperations or ICT infrastructure suggests that these play a more important role. However, we now find a positive effect of research cooperations on the likelihood that an OARE journal is cited. We also find evidence for a small impact of ICT infrastructure. The intuition behind this finding may be that sufficient research facilities (especially internet access) are provided by means

[128]This is an aspect that will have to be investigated in more detail as the project advances. We will elaborate on the proceedings of our research project in the next section.

Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7
After	.04099703***	.04002463***	.03978623***	.03992119***	.02627632**	.02620329**	.02653074**
Member	-.00844237	-.0146455*	-.01220048	-.01211408	-.00728996	-.00921224	-.00604793
AfterMember	-.00535753	-.00482974	-.00657308	-.00656629	-.00457807	-.00488112	-.00778053
OECD		.09553163***			.10667696***	.10729895***	
EU			.07983657***				.09469933***
Namerica			.08484074***				.07886207***
EU15				.07884777***			
USA				.09039255***			
Internet					.00071531***	.00076509***	.00085353***
GDP_PC_con-S						-8.312e-07	-1.446e-06
_cons	.1937593***	.14303217***	.1478618***	.14855646***	.12715622***	.12940555***	.13644117***
N	234	234	234	234	213	213	213
F	15.397865	40.909311	36.630721	36.902838	31.41048	25.995279	25.216062

legend: * p<.1; ** p<.05; *** p<.01

Fig. 4.9 Relative citations: an empirical assessment

of cooperations with co-authors from a country that has the sufficient means in terms of ICT infrastructure.

Limitations and Proceedings

Of course, by using citation data we can only indirectly measure the use of journals participating in the "Research4Life" programmes. In fact, we have to assume that a journal that was cited has also been used or accessed. The use of the "Web of Science" database from Thomson Scientific is common practice in evaluating journal use. Nevertheless, other types of journal use like browsing or reading (McCain and Bobick 1981; Ross 2008, p. 6) can not be captured with the citation measures. An option to directly measure the use of HINARI, AGORA and OARE journals would be the number of downloads by each registered institute in each country. The WHO has gathered such information. Despite our endeavour the receive this data by directly contacting the WHO, our request was rejected due to internal obligations of secrecy. An analysis of this data would give us the opportunity to not only consider scholarly use of the "Research4Life" programmes, but would also provide evidence for the use and impact of these initiatives on practitioners, like doctors or farmers.[129]

Furthermore, our analysis is also limited with regards to content. In further proceedings of our research project, our analysis will gain from advancements in two respects. First and foremost, our analysis so far only considers the OARE initiative. Further investigations will have to account for extensions to both further "Research4Life" programmes as well as OA journals in general. That is, by creating matching data of our existing country files with the journal lists of HINARI and AGORA we will be able to broaden our view to include literature in health and agriculture. So far, our investigation is still limited to literature in environmental sciences. Furthermore, in assessing the potential role of free online access to

[129]Interesting in this regard would be to examine the possible effect of HINARI on common health indicators, such as life expectancy.

academic journal content our analysis will have to be broadened to include pure OA journals.[130] We have seen that OA journals seem to play an important role especially in emerging economies like Brazil, India and Egypt.[131] Accordingly, for assessing the role of OA journals our analysis should also be broadened geographically to include these countries. Second, also our empirical assessment is still limited in many respects and will need further elaborations on problems such as omitted variable bias or differential trends in treatment and control group. One of the main assumptions in the general "DiD"-model is that the underlying trends in the outcome variable is the same for the treatment and the control group. However, as is often the case in natural experiments, this assumption is likely not met. Unlike true experiments, where we directly assure that treatment and control group only differ with regard to receipt of treatment, the setting in a natural experiment is entirely different. One may argue that the countries in our setting will necessarily differ as the treatment is subject to the economic development of a country. That is, even though we selected countries as controls that were only marginally above the threshold for being eligible for treatment, the control countries still differ in their level of economic development. Furthermore, there may also be other factors that may harm the "common trend" assumption. We tried to account for such factors by including controls into our empirical analysis, such as GDP per capita or an indicator that accounts for differences in the ICT infrastructure. A classical step forward could be the "synthetic control" method. Here, a control group is synthetically created to reflect a control set of variables based on a combination of comparison units which approximate the characteristics of the unit that receives the treatment.[132] In addition, we will include other methodological advancements of the classical "DiD"-model, such as the regression discontinuity model. This method will allow us to further elicit the causal effect of the "Research4Life" treatment by assigning a threshold that more clearly defines when a country receives the treatment. Obviously, as eligibility is defined by means of economic development, the GNI per capita of a country could be a starting point for an application of the regression discontinuity model.[133]

Despite these prevailing weaknesses of our empirical assessment and the according consciousness needed in reading the research results at this stage of the project, one message that we have pointed to earlier may be highlighted again. As OA is defined by a free availability of academic journal content without "any financial, legal, or technical barrier other than those inseparable from gaining access to the

[130]Please note that the matching data—i.e. the list of OA journals—was generated by using the metadata harvesting tool from the DOAJ. See OAI (2008) for more information on the metadata harvesting tool.

[131]See Fig. 3.9. Obviously, all three countries belong to the top ten list of most active countries in launching OA journals. See also the website of the DOAJ at http://www.doaj.org/doaj?func=byCountry&uiLanguage=en (last accessed on September 1, 2014) for an updated overview.

[132]The "synthetic control" method is a very new empirical method to account for problems associated to the common trend assumption in the "DiD"-methodology. See Abadie et al. (2010).

[133]For further information on the "degression discontinuity model" see Imbens and Lemieux (2007) and Hahn et al. (2001).

internet itself" (BOAI 2002), providing for a sufficient level of ICT infrastructure will have to be on the agenda. With other words and as emphasized previously: policy makers will have to account for both the participation constraint (funding of publication costs) and the access constraint (sufficient ICT infrastructure) when formulating and codifying OA policies on a global scale.

Chapter 5
The Future of Academic Publishing

Despite some countervailing effects of a shift from the CA to the OA model—which have to be taken into account closely in the process of reconceptualizing the predominant business model in academic publishing—there is one important conclusion from our analysis and the overall research on this intriguing topic: Open access should be the future of academic publishing (Finch 2012).

In the public debate several policy implications are discussed between the different stakeholders and advocates of the OA regime, ranging from an abolishment of copyright to the introduction of particular copyright exceptions for research purposes. Also several alternative and complementary approaches to a reform of copyright are forwarded in the debate. This chapter shall investigate the optimal policy mix for the future of academic publishing. In Sect. 5.1, we will further elaborate on the policy implications of an OA regime as the proposed future of academic publishing. We will start with an investigation for a reform of copyright. Different approaches to a reform of copyright are analyzed. Furthermore, references are made regarding the conclusions reached from our analysis of the international political economy of the overall system in the previous section. Thereafter, we will further assess the ability of alternative and complementary approaches to foster a culture of OA in academia. In Sect. 5.2, we will point to some limitations of our analysis and offer caveat for further research on some intriguing questions in shaping the future of academic publishing.

5.1 Policy Implications

In assessing the ability of a variety of different policies and seeking an optimal mix of these policies for the promotion of OA publishing needs a benchmark to which these policies should be weighted against. In this regard, primarily two features or benchmarks should create a baseline for our policy analysis. First and

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foremost, a policy should be feasible. This includes both legal as well as political feasibility. Accordingly, it should be carefully assessed whether certain policy steps are realizable or infringe certain legal rules that are granted e.g. by international conventions. Moreover, political feasibility shall consider possible political forces such as lobbying that may prohibit certain policy interventions.[1] Second, a policy should be reasonable. This feature further investigates the effectiveness of a certain policy in reaching the objectives or solving the trade-off of an optimal publishing model. Recalling the reward structure of scientific research and understanding why scientists do science leaves us with primarily two objectives: On the one hand, scholars should receive credit for their writings according to their impact for the advancement of science or knowledge. The performance of a scientist is measured by the sum of academic works weighed with their impact, i.e. the reputation/impact factor that is assigned to a particular journal. The environment for individual career advancement is competitive.[2] On the other hand, new findings/research output should be made available immediately and at minimal costs to enable for priority to discovery and maximize knowledge diffusion.[3] In this regard, we will revert to some of the countervailing effects that we concluded from our analysis in Chap. 4, which need careful considerations in specifying adequate policy measurements.

5.1.1 Reform of Copyright

Obviously, as researchers are rather motivated by means of reputation and peer recognition than financial gains from selling their academic works, one might ask why copyright protection for academic works is at all needed. In an intriguing paper, Shavell (2010) investigates this question on whether an abolishment of copyright for academic works is reasonable. As discussed before, he argues as follows: (1) scientists seek reputation which is increasing in readership, (2) readership is higher under open access and hence scholarly esteem, (3) the publication costs due to a shift towards the "author-pays" principle under open access will be covered by most universities, and (4) there are several reasons why a shift towards an open access publishing model will not be smooth without legislative steps (Shavell 2010; Eger and Scheufen 2012b, pp. 54–55). In our analysis we have pointed to several countervailing effects of a shift towards an universal OA regime by reconsidering primarily argument (3) of the Shavell model. The question now is whether a removal of copyright protection for academic works—which necessarily forces

[1] In this context, we will revert to some of the lessons learned from our analysis of the (international) political economy in Sect. 4.2.

[2] This insight has important implications for the publishing game, which should be carefully considered in assessing the reasonability of either regime. For a review of the effects of either regime in the publishing game see our model of Sect. 4.1.

[3] See Sect. 2.2.3 for a review.

an universal OA regime—is feasible and reasonable from a law and economics perspective. In this regard, a policy (law) abolishing copyright for academic works may already fail the feasibility benchmark. The primer reason for the infeasibility of an abolishment of copyright is of legal nature. Peukert (2013b) highlights that an abolishment of copyright is eventually incompatible with the Berne convention. Accordingly, Art. 2 (1) of the Berne convention expands copyright protection to all creations in literature, scientific research and art (Hansen 2005, p. 382). It is this lack in "legal feasibility" that may also explain why with the "Public Access to Science Act" a similar policy attempt failed in US congress in 2003 (Hansen 2005, p. 382; Peukert 2013b, p. 18).[4] Shavell (2010) simply omits this fundamental insight by only mentioning in a footnote that "Paul Goldstein has suggested to [him] that elimination of copyright for academic works could lead to conflict with the obligations of the United States under the TRIPS Agreement" (Shavell 2010, p. 339).[5] Beyond the feasibility requirement there are also several reasons why an abolishment of copyright is also not reasonable from an economics perspective. First and foremost, our analysis has shown that OA may not necessarily increase the effort incentives of researchers due to the rent-seeking motive in the publishing game. Furthermore, there are several other authors who have been pointing to countervailing effects of copyright removal (Mueller-Langer and Watt 2012, 2010; McCabe and Snyder 2004, 2005).[6] Most importantly, copyright may have important implications for the reputation of journals and hence scholarly esteem in the first place. If we believe in this argument, a removal of copyright would necessarily harm the ability of researchers to receive credit for their writings. As a consequence, there are several reasons—also beyond its incompatibility with international law—why an abolishment of copyright (forced OA) is not an appropriate means to promote OA publishing. However, a reform limiting the scope of copyright (i.e. exceptions and limitations of copyright protection) may be feasible and reasonable in this regard.

One option that seeks to limit the scope of copyright protection to accommodate the needs of science is the introduction of a so called "inalienable right of secondary publication".[7] Such an "inalienable right of secondary publication" would give the author more bargaining power in the contractual relationships with publishers. As we have seen, publishers typically ask for a transfer of an exclusive commercial right from the author. Nowadays, most of the journal publishers' copyright agreements do allow for some form of self-archiving by the author. Nevertheless, it is still to the publisher to decide whether an author may also deposit a copy (pre- or post-

[4] See the bill HR 2613 IH at https://www.congress.gov/bill/108th-congress/house-bill/2613 (last accessed on 09 September 2013) for more information.

[5] See also Peukert (2013b) in footnote 77 on page 19.

[6] See our short literature review in Sect. 2.3. For a broader review of the literature see Mueller-Langer and Scheufen (2013).

[7] A similar policy option is a broad and general research exemption as advocated by Hilty et al. (2008) and Hargreaves (2011). Reichman and Okediji (2012) goes even further by proposing a "tailor-made exemption for scientific research" (Reichman and Okediji 2012, pp. 1439 et seq.).

print) of her own work in an online repository. An "inalienable right of secondary publication" would give the author the freedom to deposit a pre- and/or post-print version of her journal publication. The fact that the German parliament (Deutscher Bundestag) has enacted a bill for an "inalienable right of secondary publication" on 27 June 2013 shows that a modification of copyright in this regard is generally a feasible option for strengthening the position of authors and indirectly for promoting OA publishing. Nevertheless, the feasibility of the implementation of such an "inalienable right of secondary publication" as a general exception of copyright will decisively depend on the ability of national states to achieve collective action. Most importantly, a unilateral step forward by a single nation carries the risk of weakening both authors' and publishers' position in the international competition of science. As discussed in Sect. 4.2, a reform process that forces a deliberalisation of the international copyright framework as codified under Art. 13 of the TRIPS agreement and Art. 10 of the WIPO Copyright Treaty is required for harmonizing the rules for limiting the scope of copyright and setting equal conditions in the competition of authors in the international publishing game. With regard to the reasonability of an "inalienable right of secondary publication" our assessment will depend on the specific design of the copyright exception. First and foremost, an "inalienable right of secondary publication" would give the author the freedom for reuse of her own published articles without any requirement clause. Accordingly, there is no reason to believe that such a policy could interfere with the researcher's "freedom to publish" and could hence restrict the researcher in her ability to receive credit.[8] However, a unilateral solution where, for instance, only German authors enjoy the freedom for secondary publication could easily generate the opposite effect. That is, publishers could indirectly circumvent such rules in the selection of authors. Obviously, a disputatious argument, but one that should be considered in a truly global science community.[9] Second, as the "inalienable right of secondary publication" does not impose any further conditions or requirements for authors to provide OA to their works, it may be limited in achieving the actual goal of OA—immediate and unrestricted access to scientific knowledge. In this regard, a combination of different policies may be necessary. A possible instrument may be to combine an "inalienable right of secondary publication" with a contractual requirement imposed by funding agencies.

[8] A critical comment on the "inalienable right of secondary publication"—particularly highlighting the "freedom to publish" and "freedom of contract" argument—is a report by the "Börsenverein des deutschen Buchhandels" (see Börsenverein 2011). See also Eger and Scheufen (2012b) on page 54.

[9] Of course, there are great differences between disciplines in the degree of internationalization. Nevertheless, in the process of globalization one must assume that the tendency that German researchers compete with other researchers around the globe (international publishing game) will gain importance. As a result, the conditions and rules set by the government will not only affect their own researchers, but will necessarily have effects beyond the domestic market.

5.1.2 *Alternatives and Complementary Approaches*

A complementary approach to a reform of copyright is to reach contractual commitment among researchers to deposit a copy of their un-/published paper in an institutional or subject based repository. We have already discussed the various opportunities that the government and funding agencies have to contractually regulate OA to publicly funded research. We have seen that in fact a growing amount of countries and several large funding agencies have introduced some form of OA policy that requires OA to publicly-funded research.[10] This suggests that OA mandates—i.e. a contractual commitment of the author to provide OA to her publicly-funded research—may be a feasible policy option to foster an unrestricted access to scientific knowledge. A frequently raised concern against such contractual requirements is the argument of academic freedom or particularly the constitutionally guaranteed freedom of publication. In this regard, a group of researchers among the literary scholar Roland Reuß—that became known as the "Heidelberger Appell"—have raised such concerns.[11] Taking account of these concerns, an assessment of OA mandates from both feasibility and reasonability perspectives will decisively depend on the design of such mandates. In this context, both roads of OA—i.e. the gold road (OA journals) and the green road (self-archiving or repositories)—provide options for such mandates. Obviously, a policy mandating authors to publish in OA journals only would necessarily undermine the freedom to publish and would likely forward more protest from both researchers and publishers. Not only that such a "gold mandate" would be against the law,[12] there would also be strong arguments against it from an economics perspective. We have seen that a policy should allow for a balancing of both sides, ensuring that researchers receive adequate credit for their writings and maximize knowledge diffusion at minimal costs. Accordingly, a commitment that would bind the author to publish in OA journals would—given the prevailing competitive advantage of established CA journals in terms of impact—force OA publications at the costs of lower impact/credit for authors who received such funding. Authors without such contractual constraints—for example due to private funding or other means that offer her freedom to publish—would necessarily have an advantage. That is, there are many arguments why a "gold mandate" would neither fulfil the feasibility nor the reasonability benchmark. However, our conclusions may be different when looking at the latter form of OA mandate—the "green mandate", i.e. a request or requirement to provide OA to publicly funded research by means of repositories. In

[10]See Sect. 3.2 for a review of recent developments in the OA movement. See Sect. 4.2 for a discussion of the different forms of OA mandates. See also Suber (2012) in chapter 4.

[11]For a critique of OA in general, see Reuss and Rieble (2009) and Jochum (2009). For further information about the "Heidelberger Appell" in particular, see their website at http://www.textkritik.de/urheberrecht/ (last accessed on September 1, 2014).

[12]For a comprehensive assessment on the constitutional admissibility of a "gold mandate" see Peukert (2013a) on pages 16 et seq.

this context, the "academic freedom" or "freedom to publish" argument immediately looses weight. The reason is easy to grasp: the "green mandate" leaves it to the author where to publish her works, but asks for a self-archiving of her works after a certain period of time (embargo period). The reasonability of a "green mandate", however, will decisively depend upon the design and definition of an OA policy for funding agencies.[13] Obviously, an OA request or encouragement to self-archive a pre- or post-print version of a paper seems little promising for reaching a sufficient level of OA. In fact, with the "alliance of scientific organizations" in Germany many attempts were made to encourage researchers to deposit a copy of their work in both subject-based and institutionally based repositories. In Sect. 3.2 we highlighted the "Max Planck Digital Library" (MPDL) which provides an online platform for the exchange of publications by affiliated authors. The wording of the MPG OA policy that "calls upon its academic staff to observe the principle of public availability of basic research" (*MPG OA policy*)[14] already reveals its non-binding character. Not surprisingly, Eger et al. (2013) find that less than 20 % of the 2,151 respondents of their survey show experiences with self-archiving—with large differences between the disciplines.[15] Consequently, a simple request that asks authors for self-archiving is little promising. The second OA policy option for funding agencies are OA mandates that explicitly require green OA as a contractual condition for the receipt of funding. In this regard, we already discussed different types of mandates and showed that only rights-retention mandates may guarantee that academic works do not remain non-OA.[16] In this context, the funding agencies require to retain a non-exclusive right to authorize OA throughout self-archiving platforms (Suber 2012, p. 80). In general, this form of OA mandate seems promising as it may provide with an effective tool to enhance free online availability of publicly funded research without interfering with the researcher's "freedom to publish". Nevertheless, the particular design and means by which such a rights-retention mandate is enforceable may be subject to debate. This debate may involve two general questions. On the one hand, a right retention may be reached by different means. Suber (2012) highlights the Harvard approach which pioneered this approach for universities. Here, the "faculty members vote to give the university a standing nonexclusive right [...] to make their future work OA through the institutional repository" (Suber 2012, p. 80) but with the flexibility "to opt out of the grant of permission to the university, but not out of the deposit requirement" (Suber 2012, p. 80). Another

[13] For an overview see Fig. 4.4. See also chapter 4 in Suber (2012).

[14] See the website at http://oa.mpg.de/lang/en-uk/mpg-open-access-policy/ (last accessed on September 1, 2014).

[15] See Figs. 3.6 and 3.7.

[16] Besides "rights-retention mandates", Suber (2012) also refers to "loophole mandates" and "deposit mandates". We have already seen in Sect. 4.2.1 that these types of mandates allow authors to circumvent the OA requirement by adverting to a publishers veto (loophole mandate) or by adjusting the timing (deposit mandate) of OA availability. That is, with both policies a certain degree of literature would remain non-OA.

means may consider the option to require OA by copyright legislation. We have already discussed the option of an "inalienable right of secondary publication" that gives the author more bargaining power in the contractual relationship with journal publishers. In this regard, both policies (a right-retention mandate by funding agencies and an inalienable right of secondary publication by copyright legislation) may complement one another. On the other hand, the specific design of such a mandate involves several dimensions. The first dimension may be the length of the embargo period which trades off the need to offer enough incentives for publishers to provide the necessary publishing services and the costs of banning an OA for a certain period after publication. Whether the embargo period should be 6 or 12 months after publication may then depend on many aspects and may hence differ between disciplines and countries.[17] Second, it will be debatable how to ensure that authors follow the requirement to provide OA to their publicly funded works. Here, Stodden (2009) proposes the Reproducible Research Standard (RRS) as a promising solution for both to ensure attribution and facilitate the sharing of academic works. Other approaches revert to the option to require a deposit of an electronic version at the national library which would then provide OA to all the works.[18] Third, the type or form of the work that is deposited. No doubt, an effective OA mandate would have to assure that a final version of the paper (including all changes from revisions) is made available. Other than that would leave us with an insufficient substitute for the original. Obviously, the shape of such a policy leaves us with enough caveat for further research to not only ensure the feasibility of an OA mandate for publicly funded research, but also to guarantee an effective policy framework.

Furthermore, several authors have advocated that scientific societies and universities should launch new OA journals and should hence act as a counterbalance to the dominance of commercial publishers. A closer look at the history of the academic journal publishing market actually shows that both academic societies and universities can look back on a great tradition in publishing academic journals. We have seen that the first journal titles were launched throughout the sole initiative of academic association. Commercial publishers started to enter the market for academic publishing after the second world war. The dominance of commercial publishers—with all the consequences we are currently facing (serial crisis)—is a rather new phenomenon. The vision in this process is easy to grasp: If academic societies and universities would become more active as publishers of academic journals they could create a balance weight against the prevailing dominance of commercial publishers. Two arguments are broad forward in the literature to

[17] This is an aspect that is also of interest in the research project by Thomas Eger and Marc Scheufen who analyze the differences in the OA culture between both disciplines and countries. For the German survey see Eger et al. (2013). See also Eger et al. (2014).

[18] Such an approach is e.g. the directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:167:0010:0019:EN:PDF (last accessed on September 1, 2014). See Peukert (2013b) and Hirschfelder (2008) for a discussion.

believe that this approach could be a feasible solution. First and foremost, several universities and academic societies have experiences in publishing journals.[19] A famous example is the Oxford University Press as the world's largest university press. The Oxford University Press currently offers a portfolio of 250 journal titles.[20] Second, this particular group has a strong incentive to self-enforce a change in paradigm as the universities, in general, and the university libraries, in particular, are directly affected by the constraints imposed by the serial crisis. There is no reason to believe why universities and/or academic societies are not able to launch new journal titles. However, just like OA journals in general, also these journals will necessarily lack in reputation. As a matter of fact, especially young researchers would be reluctant to publish in these journals as they would provide with a lower credit or impact as compared to well-established commercial publishers. This leaves us with the previously outlined dilemma of OA journals and the question whether the reward structure in academia may be seen as the biggest hurdle in an evolutionary process towards an OA publishing mode.

Thus, far from any exogenous market intervention a new paradigm of OA could be induced from within the system itself. In fact, a closer look at the "OA dilemma" reveals that it originates in the prevailing reward structure, i.e. the ways scholars receive credit for their performance.[21] We have seen that the general performance measurement used for assessing the standing of a researcher within her peer group is the impact factor of a journal publication. Rankings are calculated which shall display the performance of individuals or institutions based on a weighted sum of all publications, where the impact factor reflects the weight or quality of a certain publication.[22] Nowadays, the tenure procedure has evolved to unilaterally focus on (journal)[23] publications only and has induced an environment that is typically referred to as the "publish or perish" environment of scientific research.[24] Several others criticize that a "taste for rankings" paradigm has crowded out the traditional academic notion of a "taste for science", which emphasizes the

[19] See e.g. Bargheer (2006).

[20] See the website of the Oxford University Press at http://www.oxfordjournals.org/ (last accessed on September 1, 2014) for more information.

[21] A recent paper investigating the efficiency of the reward structure in academic research is Liebowitz (2014).

[22] Accordingly, the impact or reputation of a scientist within his community of peers can be calculated as the sum of all her publications weighted by their impact factors, i.e. $reputation = \sum IF_i x_i$, where x_i denotes the publication and IF_i the respective impact factor of the respective publication.

[23] Note that in some disciplines, e.g. in economics, book publications do not add any value to the career concerns of researchers, as the weight of a book publication is nearly 0. This has important implications for the incentives of a researcher.

[24] On the origin of the "publish or perish" environment see Garfield (1996). The author finds evidence for a first reference to the phrase in Wilson (1942). Wikipedia instead finds evidence for a first appearance of the phrase in a non-academic context in the book by Coolidge and Lord (1932).

relevance of motivational factors like autonomy and peer recognition as opposed to monetary rewards (Osterloh 2013, p. 106; Roach and Sauermann 2010).[25] As a matter of fact, it is exactly this "reward system" that may induce a lock-in to the traditional publishing model and may prevent an evolutionary process towards an otherwise superior OA regime. As we have seen in Sect. 3.1 there is clear empirical evidence for a reputation or impact factor advantage of established CA publishers over OA publishers. Consequently, researchers seem to be locked-in to the weak equilibrium, where especially young researcher will prefer to publish in established CA journals to receive credit for their writings.[26] Others have been pointing to this dilemma as the chicken-egg characteristic of a co-existence of both regimes (CA and OA), where publishing in a CA journal dominates any OA attempt and leaves the academic community locked-in to the weak Nash-equilibrium.[27] A solution to this "OA dilemma" may be to induce a self-enforcing process towards OA by a reconceptualization of the reward system in academia. This reconceptualization could take many different forms which could be enforced by the community of academics itself. First and foremost, performance measures and tenure procedures should not be unilateraly focused on rankings only. Consciousness about the various problems associated with rankings is important is this regard. Rankings often glorify realities. The position of a journal, institution or researcher in a ranking is easier to assess than the real quality of research. In economics, this is known as the "multiple tasking"-effect (Holmström and Migrom 1991; Ethiraj and Levinthal 2009). In complex systems, like scientific research, goals in terms of performance measurements induce a situation where easy targets (like the position in a ranking) are reached, while the often more important goals (like scientific progress and the diffusion of knowledge) are neglected (Osterloh 2013, p. 105). A solution would be the introduction of additional measurement that directly account for OA features of a researcher's CV. With other words: The degree to which a researcher provides OA to her research, both in terms of publications in OA journals or self-archiving, should be incorporated when assessing the performance of a researcher. As a consequence, such a performance measure would also account for the positive spill-overs to academia and practice likewise. Second, well-known researchers (e.g. nobelprice laureates) should take a lead in the transition towards more OA publishing. Both OA publications but also editorial positions of renown researchers could serve as a signal of valuation in the academic publishing market.[28] Last but not least, the academic

[25] A large stream of literature has been analyzing the consequences of this changing motivational pattern for the behavior of academics, especially in form of a crowding out of intrinsic motives in academia (Osterloh 2013, p. 106). In particular, see Frey (1992) and Osterloh and Frey (2000).

[26] In this regard, Mueller-Langer and Watt (2010) point to an important insight that is also neglected by Shavell (2010), i.e. scholarly esteem can not be proxied by readership only. By contrast, any researcher would prefer a more esteemed journal with low readership over a low esteemed journal with large readership.

[27] A game-theoretical analysis is provided by Hanauske et al. (2009).

[28] In this context, Suber (2012) emphasizes: "When the best journals in a field are toll-access—often the case today even if changing—green OA allows authors to have their cake and eat it too.

society should take advantage of new opportunities like "Open Assessment" for complementing the quality selection process in academic publishing. Obviously, quality selection is important to prevent from the Akerlof lemmons. However, several scholars have been criticizing the ability of the traditional "peer review" model to reach an objective selection process.[29] In this context, an Open Assessment similar to customer evaluations in online markets could be used as a means to complement the quality assessment. A broader discussion on the design of the future quality selection process seems necessary.

5.2 A Critical Perspective

Despite the numerous arguments why OA should be the future of academic journal publishing, consciousness is required in the interpretation of the impact of the various policy conclusions. In fact, there are still several questions which remain to be investigated in more detail. Most interestingly, we have seen that the real empirical impact on readership or citations is still questionable.[30] While several authors find a significant readership or citation advantage of the OA regime (Eysenbach 2006; Lawrence 2001; Lawrence and Giles 2000), others show that this advantage is declining by 7 % per year and is only 17 % taken all journals together (Davis 2009) or that there is no such advantage of the OA regime (McCabe 2011; Davis 2011; Davis et al. 2008).[31] Obviously, as our model stands or falls with the assumption of a (weakly) higher readership under OA, it is important to empirically investigate this intriguing question. Moreover, Mueller-Langer and Watt (2010) have pointed to the fact that it is not the readership alone that drives scholarly

Authors good enough to publish in the best journals may do so and still make their work OA, without waiting for high-prestige OA journals to emerge in their fields." (Suber 2012, p. 61). See also Bjoerk (2004) on page 15.

[29]There are several problems about "peer review" that are well-known in research. Let us point to two aspects: First, there is hardly any consensus on the quality assessment when a paper is reviewed by more than one researcher. The correlation between different review reports for the same paper often range from 0.09 to 0.5 (Starbuck 2005; Peters and Ceci 1982). Second, review reports show high time inconsistencies. There are several examples for research papers that were rejected for publication but later received high recognition, for instance, by the Nobel prize. Here, Akerlof (1970) in economics or Shechtman (1988) in chemistry state famous examples. See also Gans and Shepherd (1994) and Campanario (1996) for further reading. On the problems of the traditional peer review see also Osterloh (2013) on page 107.

[30]Of course, readership and citations are closely connected as a higher readership increases the likelihood of getting cited. An empirical assessment of the correlation between readership and citations is Brody and Carr (2006).

[31]Obviously, several methodological problems—such as the problem of author self-selection—challenge the empirical findings. See also Craig et al. (2007) and Gargouri et al. (2010).

esteem, but rather the impact factor of the journal.[32] The authors argue that authors would always prefer a more well-esteemed journal with low readership over a less-esteemed journal with higher readership. Consequently, future research should also analyze the impact of quality-adjusted readership on scholarly esteem.

Most importantly, our analysis focusses on the incentives of researchers only. What we have not taken into account is that a regime change will also have important implications for publishers. Obviously, if we do believe that publishers fulfil an important function in the academic publishing market—as an intermediary that provides with several publishing services,[33] such as a quality selection (peer review) or editing and typesetting tasks—there needs to be some form of renumeration for publishers. Since an OA regime induces a shift towards the "author pays" model, its impact for publishers will have to be analyzed in detail. In this regard, McCabe and Snyder (2005) have pointed to possible negative effects in form of a quality degradation of OA journals. The reason is simply market power. Even if copyright for academic works were to be removed, established publishers will be able to retain some degree of market power (Mueller-Langer and Watt 2010). Due to the reputation advantage of established publishing houses such as Reed Elsevier or Springer, these publishers will be able to raise prices above marginal costs. As a result, top-tier journals will still be able to make (substantial) profits based on the reputational capital they have accumulated in the past and that necessarily roots in the "taste for rankings" argument as discussed before. The argument by McCabe and Snyder (2005) goes even further. The authors argue that since it is the author who pays per publication, publishers could have a strong incentive to accept more papers for publications as would be socially optimal, with a negative impact for the quality of academic works under OA.[34]

Last but not least, several questions regarding the impact and the consequences of an (universal) OA regime at the international level will have to be further investigated. We have pointed to several aspects and possible distortions in a truly heterogeneous world. The vision of OA as a means for overcoming the still prevalent digital divide between the developed and the developing world may be a fallacy. In fact, several challenges especially in the international law context remain as the most serious obstacles on the road towards an universal and worldwide OA regime in academic publishing. Further assessments on the (potential) role of OA for developing countries as well as investigations focussing on the international legal

[32]This has important implications especially for the self-selection of authors. In Chap. 3 we have seen that there is a significant impact factor advantage of established CA journal publishers, the consequences of which we have discussed under the title "OA dilemma".

[33]In this regard, Bergstrom (2001) and Mueller-Langer and Watt (2010) highlight that most of these services are provided voluntarily by the academic community anyway. Consequently, the question should be to assess to what extend publishers actually add value to the production process and whether profit margins of currently 25 % or more are reasonable and justified for incentivizing publishers to publish. See also Ramello (2010) on this point.

[34]A new branch of literature investigates the consequences for authors, readers and publishers in a two-sided market model. See Jeon and Rochet (2010) and Mueller-Langer and Watt (2012).

framework (primarily copyright law issues) will be necessary to reach reasonable conclusions.

All of the above shows that there is great caveat for further research. Mueller-Langer and Scheufen (2013) highlight several further open questions that go beyond the comparison of CA versus OA publishing. Accordingly, also the consequences of "Hybrid Open Access" (HOA) should be investigated in more detail. In this regard, Mueller-Langer and Watt (2013) point to the possible negative effects of "double dipping", i.e. publishers are actually charging twice for the same article—the readers for the CA journal version and the author for the open choice option.[35] In fact, it is highly questionable whether HOA models follow the "nobel" goal of improving the accessibility of journal content, or whether they provide journal publishers with just another means to price discriminate by segmenting markets between authors and readers. Moreover, also questions concerning OA to data (to improve the replicability of (empirical) research) and online libraries (such as Google Books) offer great caveat for further research.[36]

[35]Mueller-Langer and Watt (2012) show that HOA is no substitute for the subscription model, as only a fractional amount of authors actually choose the open choice option for their articles.

[36]On OA to data see Andreoli-Versbach and Mueller-Langer (2013). On Google Books see Mueller-Langer and Scheufen (2011b).

Chapter 6
Conclusions and Further Research

In conclusion, there are several arguments to believe that the future of academic publishing should be open access. While Shavell (2010) finds that OA may strictly increase researcher's incentives due to higher readership, our analysis also points to some countervailing effects of OA, especially when reconsidering Shavell's assumption that most universities will cover the publication costs under an "author pays" model. We show that primarily due to rent seeking motives in the publishing game the incentives to exceed higher efforts may decrease. Nevertheless, we have stressed that this may just correct another distortion that the "publish or perish" environment in academia has enforced: namely the fact that "too many" papers are produced that are hardly ever read. Meho (2007) finds evidence for the fact that 90 % of all published papers are never cited and as many as 50 % of all papers are never read by anybody but the reviewer and the authors themselves. Moreover, we have pointed to the possible benefits but also the costs of OA publishing at the international level, especially when considering the position of developing countries.

The problem that the academic publishing market (but also other copyright industries) is facing is somewhat twofold: While digitalization has provided the means for a maximal access to information goods, it also offers with the technological means to maximize control over its content (Peukert 2013b, p. 15). In our historical reflection on the development of copyright we have seen that most recent reforms were primarily directed at serving the latter aspect. Accordingly, the introduction of so-called DRM technologies may have unilaterally improved the position of publishing houses (Hilty 2007). Nevertheless, we find many arguments why an abolishment of copyright—which lays the basis for an exclusive right on information goods—for academic works (Shavell 2010) is neither a feasible nor a reasonable solution. In this regard, we want to stress seven recommendations and provide an agenda for the steps ahead in shaping the future of academic publishing:

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1. *OA Mandate by Funding Agencies and Universities.* As it is not only the government but also nonprofit funding agencies who largely fund scientific research, a contractual commitment of authors to provide OA to their publicly funded research results (OA mandate) seems to offer a reasonable starting point.[1] We have seen several different forms of OA mandates. Obviously, to require authors of publicly funded research to submit to OA journals only (gold mandate) seems neither fair nor reasonable. In fact, the still low impact and hence reputation of OA journals as well as legal concerns originating in the "freedom to publish" principle of scientific research offer comprehensible arguments against such a gold mandate. Nevertheless, the "green road" of OA provides a feasible and reasonable alternative. Accordingly, funding agencies but also universities should condition their funding or employment contracts on the deposit of a copy of the final version[2] of the publicly funded work in an online repository after an embargo period of 6–12 months after first publication.[3] To ensure that all publicly funded research results are accessible in an online repository after the embargo period, only a rights-retention mandate—i.e. a mandate that allows to retain the nonexclusive right to authorize OA throughout online repositories (Suber 2012, p. 80)—seems appropriate.
2. *Monitoring of OA Mandates.* Extending on the first recommendation, only a monitoring of OA mandates will assure that authors actually self-archive their works. In this context, Stodden (2009) proposes the "Reproducible Research Standard" (RSS) as a possible solution. Similarly, other approaches revert to the option to require a deposit of an electronic version of each publicly funded paper at the national library. However, already *Friedrich August von Hayek* pointed to the several problems associated with the centralisation of knowledge.[4] Accordingly, a decentralized solution seems more appropriate for monitoring OA mandates. Especially universities and research institutions constitute entities that do not only have the information needed but also the organizational means to monitor that their employees provide OA to their publicly funded research results

[1] Here, the degree to which an academic work was publicly funded (typically 50 %) may offer a reasonable limitation or qualification of such a mandate. In fact, it will have to be ensured that privately funded research results—e.g. R&D efforts in large companies or research in private research institutions—are excluded. We have pointed to the type of literature that we have in mind when demanding OA—literature that Suber (2012) refers to as royalty free literature. Nevertheless, as also researchers at universities usually receive their salary throughout public funds one may find arguments to also require university researchers to provide OA to their works.

[2] We have pointed to the fact that only the post-print version of an academic work—that includes all changes made in the process of revision as well as editing and typesetting improvements—offers a reasonable substitute for the published version.

[3] Whether 6 or 12 months is a reasonable embargo period will depend on many aspects. Most importantly, it will depend on the conditions in different academic disciplines whether 6 or 12 months ensures that (1) publishers have an incentive to publish (first mover advantage) and (2) researchers have access to the whole stock of academic literature.

[4] See for instance Hayek (1973).

as soon as possible and in an adequate format (post-print version). One could even argue that it should be the task of the faculties to monitor. A possible means to ease the monitoring process would be the implementation of an institutional repository for each university. Affiliated authors should then be required to deposit a copy of their final paper version on the university platform.[5]

3. *Inalienable Right of Secondary Publication.* The introduction of an "inalienable right of secondary publication" as a general limitation of copyright constitutes a reasonable means to complement the functioning of OA mandates. In particular, such an "inalienable right of secondary publication" would give the author more bargaining weight in her contractual relationships with publishers and constitutes a sufficient means for a retention of the non-exclusive right by the author (rights retention mandate). Of course, the majority of publishers has already realized the "spirit of the information age" and allow for some form of self-archiving.[6] Nevertheless, it is left to the publisher whether an author may or may not self-archive a pre- and/or post-print version of her published paper. An "inalienable right of secondary publication" would ensure a more balanced relationship between publishers and authors. However, only in combination with an OA mandate such a policy would ensure the ability to achieve the actual goal of OA—immediate and unrestricted access to scientific knowledge.
4. *International Copyright Law and the Reconceptualization of the Berne Three-Step Test.* For achieving collective action in the legislative action of different national states and to avoid possible distortions between authors of different origin, a reform in the context of international law seems inevitable. We have seen that the rigidity of the current international copyright framework would necessarily impede the options for limiting the scope of copyright (e.g. by introducing an inalienable right of secondary publication)[7] at the international level. In this regard, both a recodification of the international three-step test (in accordance to the US fair-use principle) in combination with a reform process that incorporates the needs of developing countries (by incorporating users' rights provisions at the international level) is decisive for adjusting the international copyright framework to accommodate the needs of science.
5. *Transnational Funding Agency.* Our research has also pointed to possible distortions when shifting towards an OA regime. In particular, we have seen that researchers from developing countries may be restricted in their ability to bear

[5] Of course, this approach does not ban the author to deposit a copy of her work on a subject-based repository, where the work may be more visible for her peers. However, the requirement to deposit a copy of the final paper version on the university platform would necessarily ease the monitoring of the OA mandate.

[6] See the website of SHERPA/RoMEO at http://www.sherpa.ac.uk/romeo/ (last accessed on September 1, 2014) for more information on publisher's copyright policies and self-archiving.

[7] Note that a copyright exception (such as the inalienable right of secondary publication) would also ease the problems associated with the licensing of copyrighted material—which we have discussed in Sect. 4.2.1.

the publication costs in an OA world.[8] Many OA publishers have realized the dilemma of authors from developing countries and offer discounts or waivers to authors suffering from financial hardship. In the evolutionary process towards an OA regime as the future of academic publishing these basic insights should be taken into account. The implementation of a transnational funding agency as an entity for the coordination and redistribution of funds is an unavoidable consequence in this process. However, we do not see any argument for the funding of hybrid OA publications which do not follow the actual intention of OA but rather provide with an additional means for price discrimination. As a consequence, receipt of funding should be restricted to pure or true OA publications.

6. *Reconsidering the Reward Structure in Science.* We have also pointed to the prevailing "OA dilemma" in a world of two co-existing regimes (CA versus OA), where especially young researchers may be locked-in to the CA model due to the reputation advantage of established CA publishers. As a matter of fact, the dilemma that OA journals may be restricted in their ability to accumulate a sufficient level of reputation (chicken-egg problem) originates in the prevailing reward structure of science, i.e. the ways scholars receive credit for their performance. That is, the problem may somewhat be self-made. As a result, it should be in the interest of every scholar to induce a debate on a possible reconceptualization of the reward system, also to countervail against the negative effects that the "publish or perish" environment has caused. In particular, the debate should find ways to remunerate OA publications for the career concerns of researchers.
7. *Create Awareness.* Obviously, awareness about the general principles of OA will be needed to foster its evolution. Eger et al. (2013) show that the awareness about OA publishing differs considerably between disciplines and has explanatory power to explain its acceptance in particular fields. Consequently, more initiatives—like the OA weeks[9]—will be necessary to not only create awareness about OA but also to overcome prevalent prejudices against OA publishing.

Obviously, the transition towards a greater role of OA in the future of academic publishing will need time and thorough investigations of the various (unresolved) problems ahead. We have pointed to several open questions not only in the

[8] Note that under the OA model it is not the readers who pay the publication costs, but the authors. However, there are also other forms of income sources that OA publishers revert to (see Fig. 3.11). As a matter of fact, we have seen that only 28.24 % of OA publishers do actually charge author fees.

[9] Visit their website at http://www.openaccessweek.org/ (last accessed on September 1, 2014) for more information.

"copyright versus open access" debate, but especially in the international context and related topics involving aspects such as OA to data and digital libraries (e.g. Google Books).[10] All of this leaves us with a promising road for further research and intriguing questions on our very own future.

[10]Note that our analysis is restricted to academic journal articles only. That is, our analysis deliberately excludes e.g. (academic) books.

Chapter 7
Appendix

This appendix gives an overview on the data and the proofs as referred to in the text. In doing so, we follow the lines of the overall thesis structure. The following headings refer to the respective headings of the chapters to which additional information is provided. Accordingly, we will first refer to data that was used to conduct the figures and empirical tests of Chap. 3 "Academic Journal Publishing and the Open Access Movement". Accordingly, Sect. 7.1 captures the data used for the market overview in Sect. 3.1. Section 7.2 gives an overview on the data for Sect. 3.2. We will then proceed to additional information as referred to in Chap. 4 "On the Access Principle in Science: A Law and Economics Analysis". Section 7.1 provides with the proofs of Sect. 4.1. Section 7.2 gives insides to the data and approaches used in Sect. 4.2.

7.1 The Academic Journal Publishing Market and the OA Movement

7.1.1 The Academic Journal Publishing Market

Figure 7.1 provides an overview on several market characteristics for the big three journal publishers in academic publishing, i.e. Reed Elsevier, Wiley-Blackwell and Springer. Several characteristics revert back to the distribution of the impact factor, as the most important performance measurement and signal for a journal's reputation. We use data from JCR (2011) for data matching. The journal data was extracted from the ISI Thomson's Web of Science database. The market share variable was calculated using the absolute number of journals with an impact factor of at least 1(2) divided by the number of all journals with an impact factor of at least 1(2) in the market.

M. Scheufen, *Copyright Versus Open Access*, International Law and Economics,
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Publisher	Elsevier	Wiley-Blackwell	Springer	CA Journals (Big 3)
# ISI Journals	737	782	864	2383
# Journals with Impact Factor ≥ 1	609	639	546	1794
# Journals with Impact Factor ≥ 2	369	381	253	1003
Market Share (by IF ≥ 1)	0,122313718	0,128339024	0,109660574	0,360313316
Market Share (by IF ≥ 2)	0,135462555	0,139867841	0,09287812	0,368208517
# Articles	151521	133383	93974	378878
Market Share (by # Articles)	0,132264482	0,116431606	0,082031022	0,330727109
Average Impact Factor	2,668	2,575	1,637	2,264
Min Impact Factor	0,023	0,050	0,033	0,023
Max Impact Factor	38,278	38,278	11,526	38,278
Average 5 Year IF	2,952	2,816	1,842	
Average Eigenfactor	0,015	0,013	0,006	0,011
Average Number of Articles	206,151	171,208	109,252	159,552
1. Quartile	1,295	1,2015	0,738	1,062
Min	0,023	0,050	0,033	0,023
Median	2,0065	1,9735	1,3825	1,268
Max	38,278	38,278	11,526	38,278
3. Quartile	3,046	2,945	2,143	2,685

Fig. 7.1 CA publishers: market characteristics of the big three

	HINDAWI	Bio Med	PLoS*	Medknow	OA Journal (Big 4)	All OA Journals
# Journals	353	243	7	90	693	8287
# ISI listed Journals	26	106	7	14	153	829
# Journals with Impact Factor ≥ 1	14	104	7	5	130	373
# Journals with Impact Factor ≥ 2	5	76	6		87	187
Market Share (by IF ≥ 1)	0,00281181	0,02088773	0,0014059	0,00100422	0,026109661	0,074914641
Market Share (by IF ≥ 2)	0,00100422	0,01526411	0,00120506	0	0,017473388	0,037557743
Average Impact Factor	1,474	2,764	8,509	0,929	2,640094553	1,436902795
Min Impact Factor	0,203	0,791	4,092	0,311	0,203	
Max Impact Factor	4,774	7,253	16,269	1,617	16,269	
Average 5 Year IF	1,791	3,199	9,025	0,971	3,022089291	
Average Eigenfactor	0,002	0,008	0,155	0,001	0,013049804	
Average Number of Articles	119,50	130,68	2286,86	71,50	222,0109555	
Min Number of Articles	13	9	126	34	9	
Max Number of Articles	542	1009	13781	156	13781	
1. Quartile	0,663	1,98	4,9655	0,688	1,774565359	0,438
Min	0,203	0,791	4,092	0,311	0,203	0
Median	1,179	2,531	8,694	0,9675	8,694	0,88
Max	4,774	7,253	16,269	1,617	16,269	17,462
3. Quartile	1,82075	3,346	10,2895	1,124	3,201163399	1,814

Fig. 7.2 OA publishers: market characteristics of the big four

Figure 7.2 is in accordance to Fig. 7.1 and lists the respective market characteristics for OA journals. The last column also summarizes the data for all OA journals.

Figure 7.3 provides evidence for the impression of an impact factor advantage of closed access journals as compared to open access journals by means of a simple Pearson Chi^2 test. The results are significant at the 1 % level. The t-statistic of almost

row	col 1	2	3	4	5	6	7	8	9	10	Total
1	456	183	85	48	19	13	6	2	3	1	823
2	2,844	2,045	1,164	573	286	147	92	52	24	40	7,411
Total	3,300	2,228	1,249	621	305	160	98	54	27	41	8,234

row	col 11	Total
1	7	823
2	144	7,411
Total	151	8,234

Pearson chi2(10) = 96.0430 Pr = 0.000

Fig. 7.3 Pearson Chi^2 test: impact factor advantage of CA journals

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
#launched OA journals	33	519	548	564	483	540	837	758	1461	1538	1005
#aggregated OA journals	33	552	1100	1664	2147	2687	3524	4282	5743	7281	8286
# aggregated OA journals by discipline											
Agriculture & Food Sciences	0	15	55	81	105	132	166	197	255	327	388
Arts & Architecture	0	13	17	34	47	60	75	88	134	164	193
Biology & Life Sciences	8	61	117	160	197	231	306	363	448	543	629
Business & Economics	0	8	18	31	57	84	116	154	254	354	418
Chemistry	2	15	31	38	41	53	74	93	111	137	151
Earth & Environmental Sciences	3	16	34	65	98	126	172	211	257	332	378
Health Sciences	10	184	388	506	584	703	902	1098	1442	1811	2011
History & Archeology	0	6	17	39	55	71	87	105	148	170	210
Language & Literature	2	17	33	76	104	135	175	207	291	395	443
Law and Political Sciences	0	23	38	56	75	97	125	156	205	251	291
Mathematics & Statistics	2	36	47	65	86	99	128	143	175	210	236
Philosophy & Religion	0	22	31	44	60	80	102	125	168	221	244
Physics & Astronomy	0	16	26	36	41	53	80	96	105	129	142
Social Sciences	2	89	176	310	421	534	688	809	1059	1311	1471
Technology & Engineering	4	30	63	95	134	177	251	332	501	675	771
Others	0	1	9	28	42	52	77	105	190	251	310

Fig. 7.4 Development of OA journals: 2002–2012

100 provides evidence for the unequal distribution of the impact factor over journals, comparing CA with OA journals.

7.1.2 The OA Movement

Figure 7.4 gives an overview on the development of OA journals over time, also disaggregated to the discipline level.[1]

[1]Please note that the subdivision in 16 different disciplines or division follows the lines of the DOAJ. See www.doaj.org/ for more information.

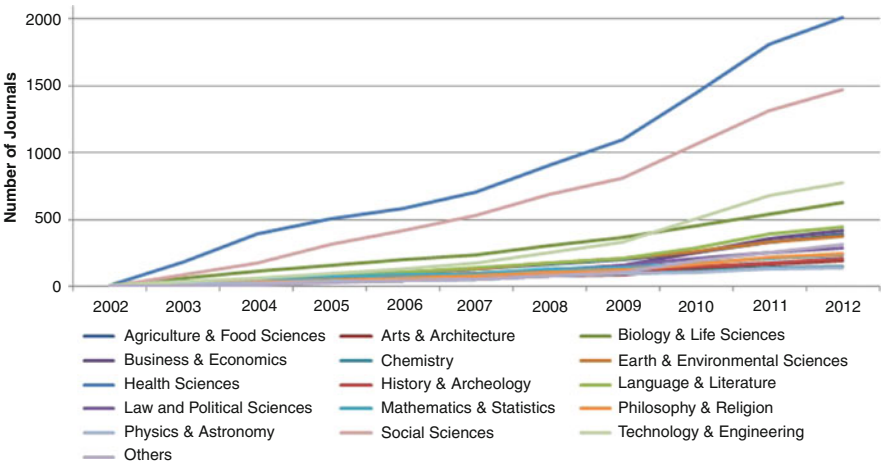

Fig. 7.5 OA journals by discipline: 2002–2012

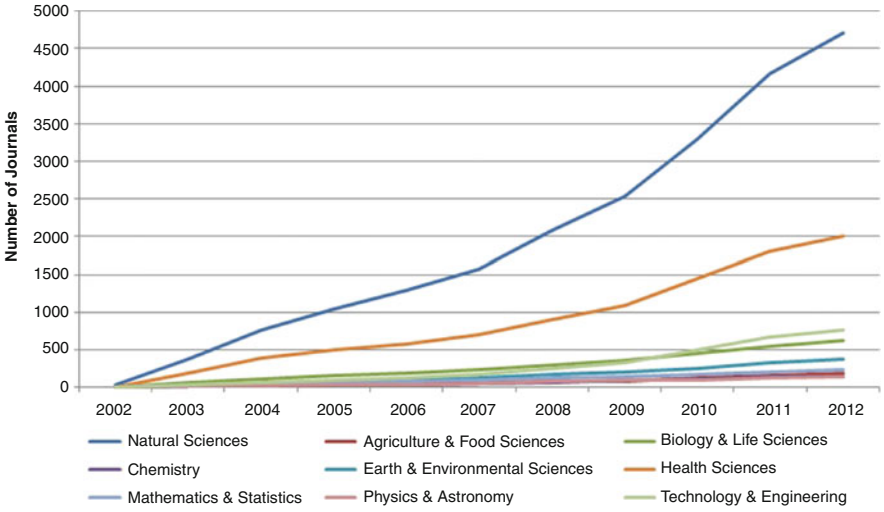

Fig. 7.6 OA journals in natural science: 2002–2012

Figure 7.5 gives an overview on the distribution of OA journals by disciplines. The lines refer to the aggregated number of journals and greatly reveal the differences between the disciplines. Two disciplines—namely Health Sciences and Social Sciences—dominate the total number of OA journals in place.

Figures 7.6 and 7.7 illustrate the differences between the disciplines by comparing natural science with other non-natural science disciplines. The natural sciences graphic shows the total number of journals aggregated by all natural science disciplines, i.e. Agriculture & Life Sciences, Biology & Life Sciences,

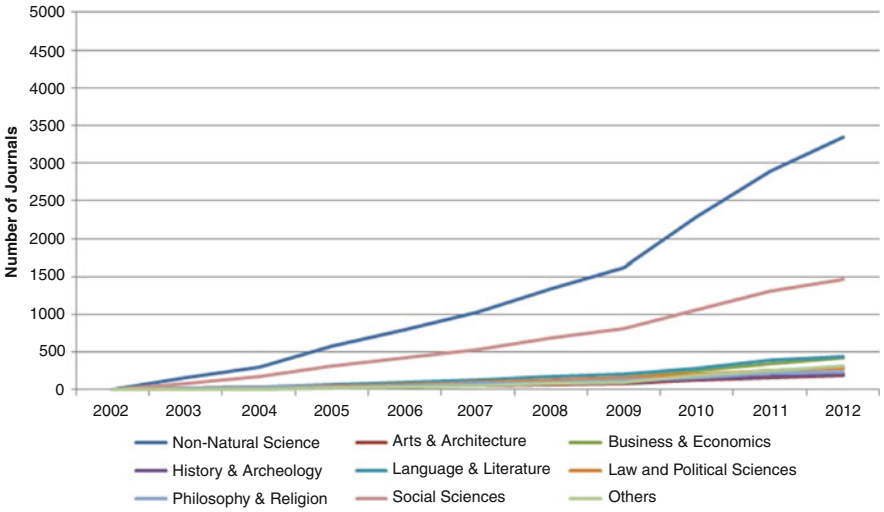

Fig. 7.7 OA journals in non-natural science: 2002–2012

Chemistry, Earth & Environmental Sciences, Health Sciences, Mathematics & Statistics, Physics & Astronomy and Technology & Engineering. The non-natural sciences consider all other disciplines. Obviously, both fields show rather similar developments, with an advantage of around 1,000 journals in the natural sciences. Both fields have one discipline that dominates in the number of journals. While in the natural sciences a majority of journals can be assigned to Health Sciences, its Social Sciences for the non-natural sciences.

7.2 On the Access Principle in Science: A Law and Economics Analysis

7.2.1 The Organization of Science: Copyright vs. Open Access

Proof of Proposition 1 Part (i). Taking the partial derivatives gives

$$\frac{\partial e_H^C}{\partial \theta} = \frac{\partial e_L^C}{\partial \theta} = r^C \frac{1-\theta}{(1+\theta)^3} < 0, \frac{\partial e_H^O}{\partial \theta} = -(1-g)\frac{\theta - 1 + g}{(1+\theta-g)^3} < 0,$$

$$\frac{\partial e_L^O}{\partial \theta} = -(1-g)^2 \frac{\theta - 1 + g}{(\theta - g + 1)^3}.$$

Part (ii). Obvious. *Part (iii)*. The ratio of efforts is $\frac{e_H^*}{e_L^*} = \frac{r^k}{r^k - g_L^k}$, and thus $e_H^* = e_L^*$ for $g = 0$ while $e_H^* > e_L^*$ for $g > 0$. Next,

$$\frac{\partial e_H^*}{\partial g} = -\frac{\left(r^O\right)^2 \theta \left(r\left(\theta - 1\right) + g\right)}{\left(r^O\left(\theta + 1\right) - g\right)^3} < 0, \tag{7.1}$$

$$\frac{\partial e_L^*}{\partial g} = -\frac{2\left(r^O\right)^2 \theta^2 \left(r^O - g\right)}{\left(r^O\left(\theta + 1\right) - g\right)^3} < 0. \tag{7.2}$$

Part (iv). From the best response functions in the text, we get

$$\frac{\partial e_H}{\partial e_L} = \frac{1}{2e_L\theta^2}\left(\left(e_L r^k \theta^3\right)^{0.5} - 2e_L\theta\right)$$

$$\frac{\partial e_L}{\partial e_H} = \frac{1}{2e_H}\left(\left(e_H\theta\left(r^k - g_L^k\right)\right)^{0.5} - 2e_H\theta\right).$$

Substituting the equilibrium values into the right hand sides of the two equations gives

$$\frac{\partial e_H\left(e_L^*\right)}{\partial e_L} = \frac{r^k\left(\theta - 1\right) + g_L^k}{2\theta\left(r^k - g_L^k\right)} > 0.$$

$$\frac{\partial e_L\left(e_H^*\right)}{\partial e_H} = -\frac{\left(r^k\left(1 + \theta\right) - g_L^k\right)^2}{2\left(r^k\right)^2\theta\left(r^k - g_L^k\right)}\left(r^k\theta\left(r^k - g_L^k\right)\frac{r^k\left(\theta - 1\right) + g_L^k}{\left(r^k\left(1 + \theta\right) - g_L^k\right)^2}\right) < 0. \blacksquare$$

Proof of Proposition 2 Recall that we have normalized $r^O = 1$. *Part (i)* and *Part (ii)* follow immediately from e_H^* and e_L^* as given in the text. *Part (iii)*. For the low type, $e_L^O > e_L^C$ iff $r^C < \frac{(1+\theta-g)^2}{(1+\theta)^2(1-g)}$. The RHS of the Inequality is increasing in θ, $\frac{\partial\left(\frac{(1+\theta-g)^2}{(1+\theta)^2(1-g)}\right)}{\partial\theta} = \frac{2g(1+\theta-g)}{(1+\theta)^3(1-g)} > 0$ and in g, $\frac{\partial\left(\frac{(1+\theta-g)^2}{(1+\theta)^2(1-g)}\right)}{\partial g} = \left(\frac{2\theta(1+\theta-g)}{(\theta+1)^2(1-g)^3}\right) > 0$. For the high type, $e_H^O > e_H^C$ iff $r^C < \frac{(1+\theta-g)^2}{(1+\theta)^2(1-g)}$. The derivatives of the RHS are $\frac{\partial\left(\frac{(1+\theta-g)^2}{(1+\theta)^2(1-g)}\right)}{\partial\theta} = \frac{2g(1+\theta-g)}{(\theta+1)^3(1-g)} > 0$ and $\frac{\partial\left(\frac{(1+\theta-g)^2}{(1+\theta)^2(1-g)}\right)}{\partial g} = \frac{(1+\theta-g)(\theta-1+g)}{(1+\theta)^2(1-g)^2} > 0$ as $\theta > 1$.

Part (iv). $\frac{\frac{e_H^O}{e_L^O}}{\frac{e_H^C}{e_L^C}} = \frac{\frac{\frac{\theta(1-g)}{((1+\theta)-g)^2}}{\frac{\theta(1-g)^2}{((1+\theta)-g)^2}}}{\frac{\frac{(r^C)^2\theta}{(r^C(1+\theta))^2}}{\frac{(r^C)^2\theta}{(r^C(1+\theta))^2}}} = \frac{1}{1-g} > 1 \text{iff } g > 0. \blacksquare$

Proof of Lemma 1 *Parts (i)* and *(ii)* follow directly from comparing the privately and the socially optimal effort levels.

Part (iii). Efforts are always too low if $\beta > \max\left(\frac{2}{\left(r^C\right)^{0.5}(1+\theta)}, \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)}, \frac{2(1-g)^{0.5}}{1+\theta-g}, \frac{2\theta^{0.5}(1-g)}{1+\theta-g}\right)$. Next, (a) $\frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)} > \frac{2}{\left(r^C\right)^{0.5}(1+\theta)}$ as $\theta > 1$. (b) Define $\Delta_1 \equiv \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)} - \frac{2(1-g)^{0.5}}{1+\theta-g}$. We show that $\Delta_1 > 0$. As $\frac{\partial \Delta_1}{\partial r^C} < 0$ and $\frac{\partial \Delta_1}{\partial g} > 0$, we consider the maximum $r^C = 1$ and the minimum $g = 0$ to get $\Delta_1 = 2\frac{\theta^{0.5}-1}{\theta+1} > 0$. (c) Define $\Delta_2 \equiv \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)} - \frac{2\theta^{0.5}(1-g)}{1+\theta-g}$. We show that $\Delta_2 \geq 0$. As $\frac{\partial \Delta_2}{\partial r^C} < 0$ and $\frac{\partial \Delta_2}{\partial g} > 0$, we consider $r^C = 1$ and $g = 0$ to get $\Delta_2 = 0$. *Part (iv)*. Efforts are always too high if $\beta < \min\left(\frac{2}{\left(r^C\right)^{0.5}(1+\theta)}, \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)}, \frac{2(1-g)^{0.5}}{1+\theta-g}, \frac{2\theta^{0.5}(1-g)}{1+\theta-g}\right)$. We know that $\frac{2}{\left(r^C\right)^{0.5}(1+\theta)} < \frac{2\theta^{0.5}}{\left(r^C\right)^{0.5}(1+\theta)}$. Next, define $\Delta_3 \equiv \frac{2}{\left(r^C\right)^{0.5}(1+\theta)} - \frac{2(1-g)^{0.5}}{1+\theta-g}$. We show that $\Delta_3 \geq 0$. As $\frac{\partial \Delta_2}{\partial r^C} < 0$ and $\frac{\partial \Delta_2}{\partial g} > 0$, we consider $r^C = 1$ and $g = 0$ to get $\Delta_2 = 0$. Thus, we are left with the candidates $\frac{2(1-g)^{0.5}}{1+\theta-g}$ and $\frac{2\theta^{0.5}(1-g)}{1+\theta-g}$. Define $R_1 \equiv \frac{\frac{2(1-g)^{0.5}}{1+\theta-g}}{\frac{2\theta^{0.5}(1-g)}{1+\theta-g}} = \frac{1}{\theta^{0.5}(1-g)^{0.5}}$ which is decreasing in g and above 1 iff $g > 1 - \frac{1}{\theta}$. Then, $\beta < \frac{2\theta^{0.5}(1-g)}{1+\theta-g}$ is the relevant condition and otherwise $\beta < \frac{2(1-g)^{0.5}}{1+\theta-g}$. ■

Proof of Proposition 3 Define the ratios under the two regimes as

$$\hat{e}_L \equiv \frac{e_L^O}{e_L^C} = \frac{\frac{\theta(1-g)^2}{(1+\theta-g)^2}}{\frac{r^C\theta}{(1+\theta)^2}} = \frac{(1+\theta)^2(1-g)^2}{r^C(1+\theta-g)^2} \tag{7.3}$$

$$\hat{e}_H \equiv \frac{e_H^O}{e_H^C} = \frac{\frac{\theta(1-g)}{(1+\theta-g)^2}}{\frac{r^C\theta}{(\theta+1)^2}} = \frac{(1+\theta)^2(1-g)}{r^C(1+\theta-g)^2} \tag{7.4}$$

From $\hat{e}_L$ and $\hat{e}_H$ we get

$$\frac{\partial \hat{e}_L}{\partial \theta} = -\frac{2g(\theta+1)(1-g)^2}{r^C(\theta-g+1)^3} < 0, \frac{\partial \hat{e}_H}{\partial \theta} = -\frac{2g(1+\theta)(1-g)}{r^C(\theta-g+1)^3} < 0 \tag{7.5}$$

$$\frac{\partial \hat{e}_L}{\partial g} = -\frac{2\theta(\theta+1)^2(1-g)}{r^C(\theta-g+1)^3} < 0, \frac{\partial \hat{e}_H}{\partial g} = -\frac{(\theta+1)^2(\theta-1+g)}{r^C(\theta-g+1)^3} < 0 \tag{7.6}$$

$$\frac{\partial \hat{e}_L}{\partial r^C} = -\frac{(1+\theta)^2(1-g)^2}{(r^C)^2(\theta-g+1)^2} < 0, \frac{\partial \hat{e}_H}{\partial r} = -\frac{(\theta+1)^2(1-g)}{(r^C)^2(\theta-g+1)^2} < 0. \tag{7.7}$$

Recalling that all efforts are too low by definition of the case considered, the claim follows. ■

Proof of Proposition 4 Recall first that we know from Lemma 1 that all efforts are too high if $\beta < \frac{2\theta^{0.5}(1-g)}{1+\theta-g}$ for $g \geq 1 - \frac{1}{\theta}$ and $\beta < \frac{2(1-g)^{0.5}}{1+\theta-g}$ for $g < 1 - \frac{1}{\theta}$. Consider first the limit case where $r^C \to r^O = 1$, so that the only difference between open to closed access is that the low type needs to pay for her submission costs. Then, both efforts are higher under closed access as $\hat{e}_L = \frac{(1-g)^2(\theta+1)^2}{(1+\theta-g)^2} < 1 \forall g > 0$ and $\hat{e}_H = \frac{(1-g)(\theta+1)^2}{(1+\theta-g)^2} < 1$ where the last inequality follows from $\frac{\partial \hat{e}_H}{\partial \theta} = \frac{-2g(1-g)(\theta+1)}{(1+\theta-g)^3} < 0$ and $\frac{\partial \hat{e}_H}{\partial g} = \frac{(\theta+1)^2(1-\theta-g)}{(1+\theta-g)^3} < 0$ together with $\frac{e_H^O}{e_H^C} = 1$ for the minimum values $\theta = 1$ and $g = 0$. Next, note that only the two efforts matter for the difference in the welfare of the two publishing modes for $r^C = 1$. And since social welfare is decreasing in efforts by definition of the case considered, welfare is higher for open access if audience is identical. Finally, social welfare for closed access is strictly increasing in r^C as

$$\frac{\partial SW^C}{\partial r^C} = \beta \left(\frac{\left(r^C\right)^{0.5} \theta^{0.5} + r^C \theta}{(1+\theta)} \right) + \beta r^C \left(\frac{\left(r^C\right)^{-0.5} \theta^{0.5} + 2\theta}{2(1+\theta)} \right) - \frac{2\theta}{(1+\theta)^2} + 1 > 0 \tag{7.8}$$

due to the fact that $\frac{2\theta}{(1+\theta)^2}$ is bounded above by 1 for $\theta \geq 1$. Therefore, $SW^O - SW^C(r^C = 1) > 0 \Rightarrow SW^O - SW^C(r^C) > 0 \; \forall r^C < 1$. ■

Proof of Proposition 5 *Part (i)*. Taking the partial derivatives gives

$$\frac{\partial e_i^*}{\partial r^k} = \frac{1}{\left(r^k - g_i\right)^2} > 0, \frac{\partial e_i^*}{\partial g_i} = -\frac{1}{\left(r^k - g_i\right)^2} < 0.$$

Part (ii). Taking the partial derivatives gives

$$\frac{\partial \theta_i^*}{\partial r^k} = -\frac{1}{\left(r^k - g_i\right)^2} < 0, \frac{\partial \theta_i^*}{\partial g_i} = \frac{1}{\left(r^k - g_i\right)} > 0.$$

Part (iii). Obvious.■

Proof of Lemma 2 Obvious, since $g_i = 0 \forall i$.■

Proof of Lemma 3 *Part (i)*. Follows the same argument as stated in Lemma 2.

Part (ii). Suppose $g_i = c \forall i$. Then

$$V_i^O(e_i, \theta_i) = \left(r^k - c\right) \theta_i e_i - e_i \forall i,$$

which is the same as the argument of *Part (i)*, where $c = 0$.

Part (iii). Assume a world with two researchers, where g differs considerably between the authors $i = 1, 2$. So that $g_1 < g_2$. Then

$$V_1^O(e_1, \theta_1) = \left(r^k - g_1\right)\theta_1 e_1 - e_i > V_2^O(e_2, \theta_2) = \left(r^k - g_2\right)\theta_2 e_2 - e_2,$$

for all other things equal. This case is equally transferable to the n person case, where $g_1 \neq g_2 \neq \ldots \neq g_n$.■

7.2.2 *The Political Economy of Access to Scientific Knowledge*

Figure 7.8 provides an overview on the relative publications per day from 2000 until 2012. All three groups are illustrated, (1) Sub-Saharan Africa (Cameroon, Congo, Ethiopia, Ghana, Kenya, Nigeria, Sudan, Tanzania, Uganda, Zambia), (2) South America (Bolivia, Columbia, Ecuador, Peru, Venezuela) and (3) the control group (Botswana, Gabon, Malaysia). The column "OARE" illustrates the absolute number of registered institutions in each of the observed countries. The average counts for both Sub-Saharan Africa and South America reflect the relative publications per day for each year, weighted by the ratio of OARE registrations in the respective sample, i.e. the weight for Cameroon, for instance, was calculated by $\frac{OARE_1}{\sum OARE_i} = \frac{27}{329}$.

Figure 7.9 illustrates the relative citations—i.e. the percentage of citations that were referred to OARE journals—from 2000 until 2012 for all countries and groups. Again, the average counts for both Sub-Saharan Africa and South America were calculated by weighting each country entry by means of the ratio of OARE registrations in the respective sample.

Figure 7.10 provides an overview on the five controls considering an affiliation of co-authors with institutions in (1) OECD countries, (2) EU countries, (3) EU

		OARE	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sub-Saharan Africa	Cameroon	27	0,50546	0,54521	0,66301	0,73425	0,81694	0,84384	1,09315	1,16712	1,33333	1,35342	1,54247	1,59452	1,58242
	Congo	19	0,13388	0,09589	0,13425	0,15616	0,15301	0,20548	0,26301	0,29041	0,27596	0,38082	0,45753	0,53973	0,53846
	Ethiopia	21	0,58743	0,54247	0,70685	0,74795	0,80601	0,77534	0,83288	1,08219	1,16393	1,38356	1,50137	1,77534	1,69780
	Ghana	28	0,49454	0,45753	0,48219	0,50959	0,54372	0,59452	0,65753	0,81918	0,94262	1,01644	1,26849	1,27397	1,36264
	Kenya	59	1,37705	1,45205	1,57260	1,64384	1,55464	1,59178	1,85753	2,13425	2,38525	2,54795	2,92329	3,37534	3,02198
	Nigeria	145	2,19672	1,84384	2,09315	2,05753	2,20765	2,80548	3,20274	4,48493	5,65027	5,94247	6,46849	5,97808	4,72527
	Sudan	2	0,21585	0,19452	0,26027	0,26027	0,27869	0,33151	0,31781	0,39726	0,43716	0,61644	0,77808	0,76986	0,67033
	Tanzania	0	0,61749	0,58630	0,64658	0,72603	0,77869	0,90411	1,09863	1,18356	1,23497	1,44110	1,59452	1,61918	1,34066
	Uganda	21	0,43716	0,48767	0,42740	0,57260	0,71038	0,68767	0,83562	1,13973	1,13388	1,42740	1,72603	1,88767	1,64835
	Zambia	7	0,17486	0,24932	0,21370	0,21644	0,19672	0,26849	0,32329	0,38630	0,42077	0,40274	0,50685	0,60000	0,55495
	Average	329	1,37684	1,23449	1,38626	1,40473	1,47660	1,75474	2,02083	2,69411	3,28185	3,48725	3,85758	3,76173	3,13090
S. America	Bolivia	45	0,18033	0,23288	0,25479	0,26849	0,30328	0,34795	0,36712	0,48493	0,54372	0,50137	0,52329	0,54521	0,45055
	Columbia	18	1,79508	1,72603	1,98356	1,95890	2,18306	2,40548	2,86301	3,79452	5,44809	6,17808	6,89315	7,84932	6,30769
	Ecuador	23	0,31421	0,25479	0,39726	0,41370	0,41803	0,53973	0,53151	0,70137	0,76776	0,90137	0,78082	0,85479	0,90110
	Peru	51	0,49727	0,63562	0,61370	0,81918	0,79508	0,93699	1,04932	1,23288	1,34699	1,53425	1,65205	1,88493	1,63736
	Venezuela	0	2,74590	2,69041	2,95616	3,02192	2,68033	3,01096	3,06301	3,19726	3,70765	3,30137	3,27671	2,89041	2,29121
	Average	137	0,53295	0,58266	0,63946	0,71997	0,75260	0,86975	0,97660	1,23454	1,52473	1,69887	1,82364	2,05557	1,73755
Control	Botswana	0	0,31148	0,30137	0,35890	0,33151	0,34973	0,34247	0,45753	0,49863	0,53279	0,48219	0,41918	0,60000	0,45055
	Gabon	0	0,12842	0,15616	0,15342	0,16438	0,16120	0,18082	0,21096	0,20822	0,22404	0,23014	0,23014	0,31507	0,26923
	Malaysia	0	2,35246	2,62740	2,74247	3,21644	3,74044	4,35616	5,11507	6,13973	7,93443	11,80274	16,17260	21,15068	21,10989

Fig. 7.8 Relative publications from 2000 until 2012

		OARE	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sub-Saharan Africa	Cameroon	27	0,21541	0,19532	0,18792	0,19063	0,20635	0,19003	0,20803	0,21691	0,23968	0,22200	0,24146	0,23020	0,27959
	Congo	19	0,16800	0,21074	0,21002	0,18863	0,21848	0,20152	0,19498	0,17667	0,21583	0,23186	0,26434	0,23591	0,24980
	Ethiopia	21	0,16122	0,14952	0,17394	0,18429	0,20670	0,20866	0,23143	0,24692	0,22113	0,21736	0,22350	0,21652	0,23242
	Ghana	28	0,14559	0,16117	0,17651	0,15680	0,16307	0,16071	0,15778	0,17582	0,19287	0,20053	0,20896	0,20729	0,22387
	Kenya	59	0,21175	0,21569	0,23449	0,22169	0,23935	0,24090	0,27343	0,25803	0,27591	0,27124	0,25714	0,26098	0,26682
	Nigeria	145	0,14282	0,15217	0,15249	0,15019	0,14562	0,15792	0,15551	0,15997	0,15380	0,15463	0,16903	0,17868	0,19638
	Sudan	2	0,16017	0,14882	0,14867	0,17261	0,15872	0,16568	0,16900	0,22305	0,15171	0,22509	0,24073	0,22397	0,23123
	Tanzania	0	0,14237	0,15678	0,14698	0,16512	0,17307	0,18279	0,20582	0,21168	0,20725	0,22069	0,24300	0,22722	0,23199
	Uganda	21	0,14996	0,15130	0,15510	0,18088	0,17835	0,17749	0,18063	0,18084	0,17430	0,18719	0,18280	0,19168	0,20912
	Zambia	7	0,12988	0,17619	0,13927	0,20130	0,21141	0,15376	0,20140	0,16012	0,15608	0,16331	0,16600	0,20298	0,18897
	Average	329	0,16429	0,17152	0,17670	0,17447	0,18057	0,18264	0,19095	0,19181	0,19530	0,19613	0,20440	0,20744	0,22443
S. America	Bolivia	45	0,25093	0,24127	0,23511	0,25068	0,27591	0,22657	0,31500	0,33115	0,33682	0,31439	0,33259	0,33205	0,32097
	Columbia	18	0,18651	0,17609	0,16751	0,14639	0,13726	0,11994	0,11182	0,09501	0,08357	0,07566	0,07236	0,06609	0,05765
	Ecuador	23	0,16868	0,21103	0,24661	0,23994	0,26052	0,23163	0,26524	0,25738	0,25240	0,27705	0,27753	0,28200	0,33710
	Peru	51	0,16531	0,18550	0,19391	0,18107	0,18279	0,19217	0,21868	0,20449	0,20628	0,23566	0,22333	0,24354	0,26853
	Venezuela	0	0,16865	0,17363	0,17753	0,17313	0,20505	0,19041	0,21096	0,18616	0,20025	0,19812	0,19628	0,22671	0,24579
	Average	137	0,19678	0,20687	0,21282	0,20926	0,22045	0,20061	0,24410	0,24059	0,24078	0,24745	0,24848	0,25576	0,26956
Control	Botswana	0	0,16744	0,15347	0,14205	0,17139	0,18056	0,20870	0,20198	0,18805	0,21276	0,18673	0,16524	0,17848	0,27800
	Gabon	0	0,20254	0,23662	0,21903	0,21179	0,23302	0,23991	0,25058	0,28264	0,27329	0,27006	0,24985	0,26930	0,28085
	Malaysia	0	0,14696	0,15725	0,17301	0,17220	0,18866	0,19824	0,21639	0,22100	0,21321	0,21709	0,22535	0,24294	0,25440

Fig. 7.9 Relative citations from 2000 until 2012

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sub-Saharan Africa	Cameroon	OECD	0,6216	0,6332	0,5909	0,7052	0,7157	0,6299	0,7018	0,6244	0,6660	0,7085	0,6572	0,6546	0,7292
		EU	0,5243	0,5678	0,4917	0,5746	0,5987	0,5195	0,5815	0,4812	0,5471	0,5526	0,5204	0,5378	0,6354
		EU15	0,5243	0,5678	0,4876	0,5709	0,5987	0,5195	0,5815	0,4789	0,5471	0,5486	0,5115	0,5258	0,6285
		Namerica	0,1459	0,1055	0,0950	0,1007	0,1204	0,1364	0,1529	0,1643	0,1475	0,1680	0,1545	0,1649	0,1771
		USA	0,1189	0,1005	0,0826	0,0933	0,0970	0,1266	0,1378	0,1549	0,1230	0,1275	0,1279	0,1375	0,1458
	Congo	OECD	0,6939	0,6286	0,7347	0,7193	0,7321	0,7600	0,8438	0,7736	0,8020	0,8705	0,8383	0,8883	0,8367
		EU	0,5510	0,5143	0,6122	0,6140	0,5893	0,5733	0,6771	0,6132	0,6436	0,6403	0,7126	0,6548	0,6122
		EU15	0,5510	0,5143	0,6122	0,6140	0,5893	0,5733	0,6771	0,6132	0,6436	0,6403	0,7126	0,6497	0,6122
		Namerica	0,1020	0,2000	0,1020	0,1404	0,1071	0,1733	0,2708	0,1887	0,2178	0,3597	0,2275	0,3706	0,3061
		USA	0,0816	0,2000	0,0612	0,1404	0,0893	0,1600	0,2396	0,1698	0,1980	0,3165	0,2096	0,3503	0,2857
	Ethiopia	OECD	0,5023	0,5707	0,5233	0,6227	0,6068	0,5548	0,6678	0,5671	0,5399	0,5663	0,5712	0,5926	0,6149
		EU	0,3907	0,4242	0,3953	0,4579	0,4237	0,4099	0,4803	0,3823	0,3850	0,3980	0,4142	0,3935	0,3754
		EU15	0,3860	0,4242	0,3953	0,4579	0,4237	0,4099	0,4770	0,3797	0,3826	0,3960	0,4124	0,3889	0,3657
		Namerica	0,1209	0,1111	0,1163	0,1172	0,1559	0,1131	0,1349	0,1316	0,1408	0,1921	0,1752	0,2114	0,2104
		USA	0,1070	0,1010	0,1047	0,0989	0,1458	0,1060	0,1217	0,1241	0,1291	0,1802	0,1661	0,2006	0,2039
	Ghana	OECD	0,6133	0,6407	0,5739	0,5968	0,6884	0,7281	0,7125	0,6455	0,6696	0,6577	0,6587	0,6624	0,6250
		EU	0,3757	0,4311	0,3636	0,3763	0,4925	0,4470	0,4917	0,3813	0,4464	0,3962	0,4147	0,3785	0,3790
		EU15	0,3757	0,4311	0,3580	0,3763	0,4925	0,4470	0,4917	0,3746	0,4435	0,3935	0,4082	0,3720	0,3750
		Namerica	0,2376	0,1737	0,1705	0,2419	0,2060	0,2488	0,2375	0,3043	0,2493	0,2803	0,2333	0,2860	0,2581
		USA	0,1657	0,1377	0,1534	0,1989	0,1809	0,2258	0,1958	0,2642	0,2348	0,2453	0,2138	0,2581	0,2419
	Kenya	OECD	0,5952	0,6698	0,6376	0,7500	0,7434	0,7367	0,7684	0,7253	0,7205	0,7204	0,7291	0,7573	0,7891
		EU	0,3730	0,4604	0,4408	0,4583	0,4728	0,4836	0,4705	0,4095	0,4215	0,4194	0,4292	0,4481	0,4709
		EU15	0,3690	0,4604	0,4390	0,4533	0,4728	0,4836	0,4705	0,4031	0,4204	0,4151	0,4255	0,4424	0,4673
		Namerica	0,2798	0,2566	0,2753	0,3533	0,3445	0,3115	0,3378	0,3440	0,3402	0,3591	0,3711	0,3872	0,4364
		USA	0,2460	0,2132	0,2387	0,3300	0,3163	0,2943	0,3142	0,3286	0,3127	0,3409	0,3468	0,3677	0,4055
	Nigeria	OECD	0,2450	0,2377	0,2552	0,2597	0,2537	0,2256	0,2190	0,1790	0,1746	0,1812	0,1842	0,2131	0,2709
		EU	0,1468	0,1575	0,1649	0,1545	0,1634	0,1318	0,1343	0,1112	0,0982	0,1088	0,1084	0,1315	0,1558
		EU15	0,1443	0,1575	0,1610	0,1531	0,1621	0,1309	0,1326	0,1106	0,0977	0,1079	0,1076	0,1306	0,1477
		Namerica	0,0883	0,0758	0,0785	0,0905	0,0879	0,0938	0,0932	0,0709	0,0716	0,0715	0,0843	0,0871	0,1163
		USA	0,0796	0,0669	0,0733	0,0866	0,0842	0,0850	0,0847	0,0678	0,0672	0,0669	0,0796	0,0802	0,1081
	Sudan	OECD	0,4557	0,5070	0,5579	0,4632	0,5392	0,4215	0,5690	0,4621	0,5125	0,4711	0,4718	0,4448	0,4508
		EU	0,3797	0,3944	0,4421	0,3263	0,4020	0,3554	0,4310	0,3724	0,4063	0,3511	0,3204	0,3594	0,3361
		EU15	0,3797	0,3944	0,4421	0,3263	0,4020	0,3554	0,4310	0,3586	0,4063	0,3511	0,3204	0,3452	0,3361
		Namerica	0,0633	0,0704	0,1053	0,1263	0,0686	0,0331	0,0862	0,0552	0,0750	0,1067	0,1444	0,1068	0,1557
		USA	0,0633	0,0704	0,0947	0,1263	0,0490	0,0248	0,0776	0,0552	0,0625	0,0933	0,1444	0,0996	0,1475
	Tanzania	OECD	0,6681	0,7383	0,7458	0,8038	0,7719	0,7970	0,7830	0,7708	0,8053	0,7719	0,8024	0,7953	0,8484
		EU	0,5044	0,5421	0,5254	0,5698	0,5789	0,5152	0,5436	0,5046	0,5221	0,4886	0,5584	0,5499	0,5533
		EU15	0,5044	0,5421	0,5254	0,5698	0,5789	0,5121	0,5362	0,5023	0,5177	0,4848	0,5533	0,5465	0,5533
		Namerica	0,1460	0,1963	0,1780	0,2151	0,2596	0,3091	0,2469	0,2731	0,2743	0,2490	0,3213	0,2876	0,3525
		USA	0,1327	0,1402	0,1568	0,1925	0,2211	0,2697	0,2369	0,2500	0,2588	0,2338	0,2955	0,2724	0,3320
	Uganda	OECD	0,2188	0,2022	0,2885	0,3062	0,3423	0,2948	0,2885	0,2620	0,3229	0,3033	0,3079	0,3541	0,3133
		EU	0,0313	0,0225	0,0192	0,0239	0,0154	0,0279	0,0295	0,0409	0,0337	0,0537	0,0556	0,0610	0,0733
		EU15	0,0313	0,0112	0,0128	0,0239	0,0115	0,0239	0,0230	0,0264	0,0289	0,0461	0,0476	0,0479	0,0667
		Namerica	0,2125	0,1798	0,2756	0,2584	0,2962	0,2311	0,1967	0,1827	0,2506	0,1919	0,2222	0,2569	0,2300
		USA	0,2063	0,1629	0,2692	0,2536	0,2962	0,2231	0,1869	0,1755	0,2410	0,1900	0,2159	0,2482	0,2233
	Zambia	OECD	0,7656	0,7692	0,7692	0,6835	0,7639	0,7959	0,8305	0,8440	0,8182	0,8503	0,8919	0,8721	0,9010
		EU	0,6250	0,4835	0,5000	0,3924	0,4167	0,3571	0,3559	0,4184	0,3636	0,3741	0,3946	0,3836	0,4059
		EU15	0,6250	0,4835	0,5000	0,3924	0,4167	0,3571	0,3559	0,4113	0,3636	0,3741	0,3892	0,3744	0,3960
		Namerica	0,2344	0,1758	0,3333	0,3291	0,3611	0,3673	0,4068	0,4397	0,5065	0,4762	0,5243	0,4749	0,5248
		USA	0,2188	0,1648	0,3205	0,3038	0,3472	0,3673	0,3983	0,4326	0,4805	0,4626	0,4973	0,4658	0,5248

Fig. 7.10 Research cooperations: Sub Saharan Africa from 2000 until 2012

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
S. America	Bolivia	OECD	0,8030	0,7882	0,8280	0,8367	0,8559	0,8976	0,8358	0,8588	0,8392	0,8415	0,8534	0,8141	0,9024
		EU	0,5000	0,4353	0,5591	0,5612	0,5766	0,6614	0,5821	0,5593	0,5980	0,6230	0,5707	0,5578	0,6098
		EU15	0,5000	0,4353	0,5591	0,5612	0,5766	0,6614	0,5672	0,5480	0,5930	0,6120	0,5654	0,5427	0,6098
		Namerica	0,3030	0,2824	0,3441	0,2755	0,3604	0,2992	0,2388	0,2542	0,3618	0,4044	0,3665	0,3317	0,3659
		USA	0,3030	0,2588	0,3441	0,2755	0,3243	0,2598	0,2239	0,2316	0,3116	0,3880	0,3560	0,3015	0,3171
	Colombia	OECD	0,5464	0,5683	0,5511	0,5776	0,5782	0,5968	0,5713	0,5004	0,4468	0,4683	0,4785	0,4946	0,5383
		EU	0,3090	0,3190	0,3149	0,3357	0,3304	0,3713	0,3378	0,2794	0,2673	0,2838	0,2921	0,2859	0,2831
		EU15	0,3044	0,3095	0,3094	0,3329	0,3279	0,3679	0,3378	0,2780	0,2658	0,2820	0,2870	0,2740	0,2761
		Namerica	0,2405	0,2619	0,2348	0,2294	0,2616	0,2574	0,2507	0,2332	0,1876	0,2098	0,2099	0,2255	0,2761
		USA	0,2283	0,2508	0,2238	0,2168	0,2491	0,2426	0,2239	0,2108	0,1735	0,1947	0,1959	0,2143	0,2587
	Ecuador	OECD	0,6696	0,6667	0,7310	0,7152	0,7908	0,7970	0,7629	0,8047	0,8221	0,8085	0,7895	0,8526	0,8598
		EU	0,4522	0,4946	0,5034	0,4437	0,4706	0,4721	0,4794	0,4531	0,5374	0,5441	0,5228	0,5865	0,5488
		EU15	0,4522	0,4946	0,5034	0,4437	0,4706	0,4619	0,4794	0,4492	0,5267	0,5289	0,5158	0,5705	0,5427
		Namerica	0,4261	0,3441	0,3655	0,3046	0,4248	0,4670	0,4536	0,4609	0,4769	0,4529	0,4351	0,4519	0,5366
		USA	0,4261	0,3441	0,3448	0,3046	0,4183	0,4619	0,4175	0,4375	0,4520	0,4377	0,4175	0,4199	0,5244
	Peru	OECD	0,6978	0,6897	0,7411	0,7726	0,7595	0,7953	0,8198	0,7844	0,8012	0,7750	0,7794	0,8096	0,7886
		EU	0,2912	0,2845	0,3795	0,3712	0,3608	0,3509	0,3734	0,4111	0,3955	0,4036	0,4046	0,4360	0,4530
		EU15	0,2857	0,2845	0,3795	0,3612	0,3540	0,3450	0,3629	0,4067	0,3915	0,4000	0,3964	0,4273	0,4430
		Namerica	0,4231	0,4267	0,4107	0,4415	0,4708	0,4854	0,5170	0,4556	0,4746	0,4571	0,4975	0,4767	0,4832
		USA	0,4121	0,4095	0,3973	0,4147	0,4433	0,4474	0,4804	0,4111	0,4564	0,4339	0,4660	0,4375	0,4799
	Venezuala	OECD	0,3622	0,4318	0,4124	0,4225	0,4638	0,4904	0,4732	0,4319	0,4340	0,4332	0,4766	0,4834	0,5372
		EU	0,2100	0,2373	0,2252	0,2267	0,2793	0,2912	0,2916	0,2416	0,2366	0,2622	0,2943	0,3118	0,3525
		EU15	0,2060	0,2301	0,2206	0,2239	0,2712	0,2839	0,2862	0,2391	0,2321	0,2589	0,2893	0,3052	0,3525
		Namerica	0,1473	0,1945	0,1881	0,1949	0,2130	0,2020	0,1941	0,1877	0,1857	0,1784	0,2023	0,1981	0,2230
		USA	0,1363	0,1772	0,1696	0,1840	0,1906	0,1838	0,1771	0,1671	0,1695	0,1676	0,1781	0,1877	0,2038

Fig. 7.11 Research cooperations: South America from 2000 until 2012

15 countries, (4) countries from North America and (5) the USA.[2] Figure 7.10 is restricted to the countries of the Sub-Saharan Africa sample only. The same overview for the South American sample is Fig. 7.11. All the numbers reveal percentages of papers in each year that were produced in cooperation with at least one co-author affiliated with an institution from an (1) OECD country, (2) EU country, (3) EU 15 country or a country from (4) North America or the (5) USA. Obviously, since the USA or the memberstates of the EU are also members of the OECD, there are overlaps. In comparing variables (2) and (3) as well as variables (4) and (5) we get an impression on the importance of the core of EU countries and particularly the USA for cooperations of researchers from the developing world. Moreover, a comparison or the variables (2) and (3) with the variables (4) and (5) allows interpretations on cooperations in an EU/US comparison. Last but not least, comparing variable (1) with all other variables [variables (2)–(5)] shows that other OECD countries outside the EU or North America hardly play any role for research cooperations with the developing world.

[2]In doing so, we created five dummy variables for each single publication to control for co-authors affiliated with institutions from (1) OECD countries, (2) EU countries, (3) EU 15 countries, (4) countries from North America and the (5) USA. That is, the dummy took the value 1 if at least one co-author was affiliated with such an institution, 0 if not. With other words: For publications that were referred to authors solely from developing countries, the value was 0. For all others, some form of cooperation with the developed world was found.

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Sub-Saharan Africa	Cameroon	Internet users per 100	0,25	0,28	0,36	0,59	0,98	1,40	2,03	2,93	3,40	3,84	4,30	5,00
		GDP PC constant USD	592,37	605,16	615,29	625,78	634,51	634,72	640,76	647,94	650,04	648,49	653,03	665,80
	Congo	Internet users per 100	0,01	0,01	0,09	0,13	0,20	0,24	0,30	0,37	0,44	0,56	0,72	1,20
		GDP PC constant USD	86,75	82,66	83,08	85,28	88,24	92,37	94,77	97,91	101,10	101,17	105,53	109,81
	Ethiopia	Internet users per 100	0,02	0,04	0,07	0,11	0,16	0,22	0,31	0,37	0,45	0,54	0,75	1,10
		GDP PC constant USD	122,77	129,70	128,52	122,33	135,81	148,78	161,20	176,24	191,01	202,92	217,82	229,14
	Ghana	Internet users per 100	0,15	0,20	0,83	1,19	1,72	1,83	2,72	3,85	4,27	5,44	9,55	14,11
		GDP PC constant USD	259,99	263,96	269,23	276,41	284,85	294,41	305,75	317,74	336,35	341,55	360,32	402,70
	Kenya	Internet users per 100	0,32	0,62	1,21	2,94	3,02	3,10	7,53	7,95	8,67	10,04	14,00	28,00
		GDP PC constant USD	406,52	411,07	402,63	403,68	413,32	426,52	442,02	461,02	456,25	456,77	470,58	478,22
	Nigeria	Internet users per 100	0,06	0,09	0,32	0,56	1,29	3,55	5,55	6,77	15,86	20,00	24,00	28,43
		GDP PC constant USD	371,77	374,17	370,81	399,06	430,58	442,72	458,63	476,21	492,27	513,50	540,69	565,99
	Sudan	Internet users per 100	0,03	0,14	0,44	0,54	0,79	1,29	8,09	8,66	10,16			
		GDP PC constant USD	358,53	371,78	382,80	400,90	411,73	427,45	464,13	498,57	519,28	536,57	549,86	561,84
	Tanzania	Internet users per 100	0,12	0,17	0,22	0,68	0,88	4,30	5,80	7,20	9,00	10,00	11,00	12,00
		GDP PC constant USD	307,99	318,26	332,37	346,07	363,35	379,68	394,22	410,68	428,76	441,51	458,79	473,88
	Uganda	Internet users per 100	0,16	0,24	0,38	0,46	0,72	1,74	2,53	3,67	7,90	9,78	12,50	13,01
		GDP PC constant USD	255,78	260,74	274,60	283,08	292,68	301,26	323,08	339,06	356,84	370,54	379,99	392,71
	Zambia	Internet users per 100	0,19	0,23	0,48	0,98	2,01	2,85	4,16	4,87	5,55	6,31	10,13	11,50
		GDP PC constant USD	318,93	326,59	329,74	338,88	349,09	359,07	372,08	385,12	396,34	410,32	434,66	443,92
South America	Bolivia	Internet users per 100	1,44	2,12	3,12	3,51	4,44	5,23	6,20	10,50	12,50	16,80	22,40	30,00
		GDP PC constant USD	1010,91	1007,38	1012,13	1019,61	1042,41	1069,02	1101,04	1132,21	1182,46	1202,78	1232,69	1276,13
	Columbia	Internet users per 100	2,21	2,85	4,60	7,39	9,12	11,01	15,34	21,80	25,60	30,00	36,50	40,40
		GDP PC constant USD	2511,97	2512,52	2534,33	2592,38	2688,51	2772,21	2913,48	3068,48	3131,18	3137,70	3218,07	3362,47
	Ecuador	Internet users per 100	1,46	2,67	4,26	4,46	4,83	5,99	7,20	10,80	18,80	24,60	29,03	31,40
		GDP PC constant USD	1291,34	1337,82	1382,48	1403,49	1501,80	1562,33	1610,97	1618,87	1710,53	1692,07	1728,05	1837,01
	Peru	Internet users per 100	3,08	7,58	8,97	11,60	14,10	17,10	20,70	25,20	30,57	31,40	34,77	36,50
		GDP PC constant USD	2060,58	2036,16	2110,14	2167,73	2248,41	2374,30	2529,84	2725,82	2961,79	2955,19	3180,37	3359,52
	Venezuela	Internet users per 100	3,36	4,64	4,92	7,52	8,43	12,59	15,28	20,91	25,99	32,86	37,56	40,44
		GDP PC constant USD	4818,71	4890,93	4377,38	3966,50	4610,49	5000,08	5401,42	5777,63	5984,14	5700,88	5528,36	5671,91
Control	Botwana	Internet users per 100	2,90	3,43	3,39	3,35	3,30	3,26	4,29	5,28	6,25	6,15	6,00	7,00
		GDP PC constant USD	3204,12	3268,36	3516,21	3691,88	3865,86	3880,27	4025,40	4160,66	4223,23	3965,19	4189,69	4377,56
	Gabon	Internet users per 100	1,22	1,35	1,94	2,66	2,98	4,89	5,49	5,77	6,21	6,70	7,23	8,00
		GDP PC constant USD	4102,62	4097,56	3999,95	4015,11	3988,36	4029,27	3999,64	4143,33	4161,43	4027,57	4213,88	4333,81
	Malaysia	Internet users per 100	21,38	26,70	32,34	34,97	42,25	48,63	51,64	55,70	55,80	55,90	56,30	61,00
		GDP PC constant USD	4005,56	3933,94	4052,88	4194,26	4385,97	4529,60	4695,23	4905,12	5057,83	4901,55	5168,69	5345,21

Fig. 7.12 ICT infrastructure and GDP

Figure 7.12 illustrates both indicators (1) internet access per 100 inhabitants and (2) GDP per capita in constant US dollars, referring to both ICT infrastructure [indicator (1)] and the level of economic development [indicator (2)].[3]

The summary statistics that form the basis for our empirical analysis are reported in Fig. 7.13. Please note that the summary statistics as outlined here are aggregated numbers. For a country specific investigation see the descriptive statistics as outlined in the text of Sect. 4.2.2. Please note also that the number of observations is with 213 for the variable "Internet" lower as the total number of country observations ($N = 234$). The reason is that for some countries and years we observe missing data in the dataset. For other ICT control the missing values are even larger. The same holds for the "GDP per capita in current US dollars" variable. The larger N in both sets also drives our selection of both variables. This also explains why we observe a lower N in models 5–7 of our empirical analysis. Recall Figs. 4.8 and 4.9

[3]Please note that at the time of data extraction the World Bank data for 2012 was not provided. Moreover, the values for Sudan on "Internet users per 100" in the years 2009, 2010 and 2011 were missing.

Variable	Obs	Mean	Std. Dev.	Min	Max
Country_No	234	9.5	5.199249	1	18
Country_La~l	0				
Group	234	1.611111	.7572571	1	3
Year	234	2006	3.749678	2000	2012
Days	234	351.1538	48.93696	182	366
No_Pub	234	568.4957	860.5231	35	7720
Rel_Public~s	234	1.665043	2.63496	.0958904	21.15068
Rel_Citati~s	234	.202895	.0486552	.0576509	.337099
After	234	.4615385	.4995872	0	1
Member	234	.8333333	.3734769	0	1
AfterMember	234	.3846154	.4875471	0	1
OECD	234	.6088827	.216607	.1745648	.9848485
EU	234	.3981998	.2077822	.0153846	.9821429
EU15	234	.3945785	.2090615	.011236	.9821429
Namerica	234	.2375422	.1241687	.0330579	.5365854
USA	234	.221147	.1205838	.0247934	.5247525
Broadband	193	157292.7	453452.9	0	3256616
Broadban~100	193	52.33566	719.7068	0	9999
Internet	213	9.604104	12.98485	.0059021	61
ICT_Servers	162	170.2654	807.7955	1	9999
ICT_Server~o	162	65.93988	785.2969	.0078924	9999
Telephone	198	1382474	2082676	3500	7928944
Telephon~100	216	5.470239	6.468414	.0057592	24.90779
Journals	180	176.5517	204.1865	2.8	1351.3
GDP_PC_con~S	216	1634.404	1707.331	82.66194	5984.145
GDP_PC_cur~S	216	2415.875	2756.296	86.75451	13657.75
GDP_PC_gro~h	216	2.876795	3.296315	-10.5	16.23571
GNI_PC_con~S	191	1702.332	1668.465	57.28887	6001.755
GNI_PC_gro~h	194	2.865353	7.246025	-36.98475	72.52922
GNI_PC_cur~S	216	2182.269	2448.164	80	11820

Fig. 7.13 Summary statistics

for the results examining the effect of OARE (and other factors) on the performance measures *relative publications* and *relative citations*, respectively.

Our empirical examination in the text looks at the complete timespan, including all journal publications of the countries of interest from January 2000 until June 2012. Here, the starting point of OARE is set at the year of 2007. However, as the process of writing until the final publication involves time, one may argue that a timelag should be included to account for the large time horizon between having had access to OARE journals for the first time (October 2006) and creating a publication on their basis. In doing so, we considered a 1 year time gap. For matters of symmetry we dropped the data for 1 year before and 1 year after the launch of the OARE initiative. Accordingly, the time period before the OARE initiative was set at 2000 until 2005. The time period after the launch of OARE was set to 2008 until 2012. The summary statistics are reported in Fig. 7.14.

Variable	Obs	Mean	Std. Dev.	Min	Max
Country_No	180	9.5	5.202599	1	18
Country_La~l	0				
Group	180	1.611111	.757745	1	3
Year	180	2006	4.254475	2000	2012
Days	180	347	55.15524	182	366
No_Pub	180	587.75	940.1572	35	7720
Rel_Public~s	180	1.750051	2.901334	.0958904	21.15068
Rel_Citati~s	180	.202699	.0497199	.0576509	.337099
After	180	.5	.5013947	0	1
Member	180	.8333333	.3737175	0	1
AfterMember	180	.4166667	.4943818	0	1
OECD	180	.6046904	.2156201	.1745648	.9821429
EU	180	.397964	.2081239	.0153846	.9821429
EU15	180	.3943643	.2093822	.011236	.9821429
Namerica	180	.2367978	.124582	.0490933	.5365854
USA	180	.2206682	.1216846	.0400259	.5247525
Broadband	143	168479.4	501328	0	3256616
Broadban~100	143	70.48382	836.1124	0	9999
Internet	159	9.74011	13.32499	.0059021	61
ICT_Servers	113	210.5487	961.884	1	9999
ICT_Server~o	113	93.16867	940.2188	.0078924	9999
Telephone	144	1366601	2089360	9733	7928944
Telephon~100	162	5.491059	6.553589	.0179913	24.90779
Journals	126	173.0524	206.6499	2.8	1351.3
GDP_PC_con~S	162	1623.644	1696.66	82.66194	5984.145
GDP_PC_cur~S	162	2406.695	2844.787	86.75451	13657.75
GDP_PC_gro~h	162	2.448303	3.459236	-10.5	16.23571
GNI_PC_con~S	143	1692.106	1656.123	57.28887	6001.755
GNI_PC_gro~h	145	2.484752	8.073331	-36.98475	72.52922
GNI_PC_cur~S	162	2183.765	2526.504	80	11820

Fig. 7.14 Summary statistics: with timelags

Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7
After	-.06772055	-.15360164	-.24690127	-.26804854	-.2008281	.11809911	.19149119
Member	.29555403	.10749018	-.05061606	-.06979384	.30663188	1.893513***	1.9389013***
AfterMember	.55231269*	.73227989**	.82228228***	.84278981***	.34062224	.6290624***	.57451523***
OECD		-1.6617881***			-1.9193578***	-1.3946267***	
EU			-1.385989***				-.82392168***
Namerica			-.91204946*				-2.0837572***
EU15				-1.4107038***			
USA				-.99632974*			
Internet					.04659225***	-.02565076***	-.01824636***
GDP_PC_con~S						.00048902***	.00049645***
_cons	.44293177**	1.6946124***	1.5956047***	1.6279108***	1.5815768***	-.6605002***	-.81892711***
N	180	180	180	180	158	158	158
F	9.9855293	14.884559	10.297397	10.599509	40.248438	55.418566	64.33293

legend: * p<.1; ** p<.05; *** p<.01

Fig. 7.15 Relative publications: an empirical analysis with timelags

The results examining the effect on *relative publications* and *relative citations* are reported in Figs. 7.15 and 7.16, respectively. Apparently, including a timegap does not significantly change our results and interpretation as compared to the results in Figs. 4.8 and 4.9 of the main text.

Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7
After	.05297015***	.04918974***	.04722237***	.04749245***	.03202404***	.0318778***	.03107823***
Member	-.00102556	-.00829099	-.00675572	-.00653579	-.00131876	-.00279306	-.0009342
AfterMember	-.01010484	-.00951937	-.00975057	-.00982739	-.00881011	-.00906776	-.01134325
OECD		.09740211***			.11112656***	.11168684***	
EU			.0819801***				.09690629***
Namerica			.08747637***				.08415306***
EU15				.08104506***			
USA				.09233379***			
Internet					.00074723***	.00079137***	.00084465***
GDP_PC_con-S						-6.615e-07	-1.391e-06
_cons	.18299021***	.13368796***	.13903584***	.13974748***	.11743628***	.11916532***	.12834242***
N	180	180	180	180	159	159	159
F	18.275115	41.763288	37.279331	37.527945	31.328746	25.914333	24.411945

legend: * p<.1; ** p<.05; *** p<.01

Fig. 7.16 Relative citations: an empirical assessment with timelags

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About the Author

Marc Scheufen was a Ph.D. student and a grant holder at the DFG Graduate School "The Economics of the Internationalization of the Law" and the Institute of Law and Economics, University of Hamburg, Germany. He studied economics at the Philipps-University of Marburg, where he graduated in July 2010. After conducting research as an intern and later visiting researcher at the Max Planck Institute for Competition Law and Intellectual Property in Munich, he joined the team at the DFG Graduate School in summer 2010. Marc Scheufen has been engaged in several research projects, including a project on "Academia & Publishing" which was run by Giovanni Ramello, Ted Bergstrom and Dietmar Harhoff. He was a visiting researcher at the University of California, Berkeley (Boalt Hall School of Law) from August 2012 until December 2012 and at the Collegio Carlo Alberto in Turin, Italy from February 2011 until April 2011. In July 2012, Mr. Scheufen and his co-author Frank Mueller-Langer received the "Best Paper Prize" by the Society of Economic Research on Copyright Issues (SERCI) at the society's annual congress in Washington DC, USA for their paper "The Google Book Search Settlement: A Law and Economics Analysis" as the best paper published in the Review of Economic Research on Copyright Issues (RERCI) in the year 2011. Mr. Scheufen's research interests cover the economics of intellectual property rights, especially copyright law, applied microeconomics as well as topics in innovation and competition policy.

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