The theoretical origin of the knowledge-sharing mode of open access: From knowledge communism to academic capitalism

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Abstract
This paper adopts the science and technology studies perspective to explore the theoretical origin of open access to knowledge against the historical background of the interaction between science and society, as well as to clarify the benefit allocation and adjustment relations of different actors in the implementation process of the open-access mode. Focusing on the theoretical origin and realistic influence of open access, this paper investigates the historical changes of scientific knowledge from the common good to profitability and discusses different interpretations held by knowledge communism and academic capitalism concerning the property rights and social functions of scientific information. It also examines the role of commercial capital in commercializing academic resources and the substance of that commercialization. As a knowledge-sharing mode, open access is inevitable and rational. However, this mode involves many social problems, and there is a need to provide appropriate policies and systems.

Keywords
Open access, scientific community, knowledge communism, knowledge production

1. Introduction
Open Access is a knowledge-sharing mode introduced in the 1990s. The rapid advance of information technologies has accelerated the scientific community’s demand for scientific papers. To seek extra-high profits, publishers started to sell scientific papers to the scientific community as traded products through IP address authentication, single-paper subscriptions and other means. In recent years, as publishers have significantly increased the purchase price of access to scientific paper databases and
other resources, many universities and research institutes are increasingly unable to pay the high subscription fees. As a result, the problems of information barriers and knowledge gaps in scientific communication have become increasingly serious, and the public also finds it more difficult to access information on cutting-edge scientific achievements (Contreras, 2013).

To address those problems, people in various social sectors have called for and promoted the open-access mode, which attempts to build an open and shared environment for academic communication based on the internet. Much progress has been made in promoting open access, but new social problems have been created, involving publication costs, knowledge quality control and social visibility. Those problems have raised new issues in the field of science and technology studies (STS): What are the root causes of today’s knowledge divide in scientific communication? In what sense have business groups interfered with what Vannevar Bush called the social contract for science? At the national level, how can the information barriers to knowledge exchange be removed? How should policy reconfiguration balance the interests of different actors?

Many scholars have conducted research on these issues. For example, Scheufen (2015) studied the visible industrial concentration in academic journal publishing after commercial capital entered the field of scientific communication. Mossoff (2015) studied the significant differences between scientific papers and physical objects in the fields of production and consumption. Eger et al. (2015) studied the impact of scientists’ academic prestige on the public visibility of open-access journals. Jackson and Richardson (2014) explored the current development of open access and its possible future shape. Parker (2013) analysed the potential academic ethical problems of open access and proposed a feasible solution.

Compared with their foreign counterparts, Chinese scholars are still in the early stages of research in this area. Most of their studies focus on the realization of open access and its technical features. Few have provided a perspective from within the scientific community.

2. The introduction of knowledge communism and its implications

RK Merton (2000), the founder of the sociology of science, believed that science should be viewed as an independent social system that performs the social function of producing scientific knowledge, providing knowledge products to society and receiving funding from society. To clarify the difference between scientific knowledge and other social products, Merton (1942) explained the normative structure of science in ‘A note on science and democracy’ (later published as ‘The normative structure of science’), underscoring the important role played by the ethos of science (that is, universalism, communism, disinterestedness and organized scepticism) in the production of scientific knowledge. The communism ethos points to the social nature of knowledge; that is, the production of new knowledge results from the continuous accumulation of earlier research outcomes. Such an empirical view of science is an important methodological presupposition of the knowledge communism principle. If research activities are essentially a collective action of society, generating maximum benefits for society should naturally become the basic goal of scientific research.

The structural–functionalist approach, followed by early science sociologists, focused more on the uniqueness of the internal structure of scientific systems and on the operational norms and values of science. Hess (2011) called the sociology of science the ‘institutional sociology of science’ and stressed the professional perspective of its research agenda. Ben-David and Sullivan (1975) argued that ‘the sociology of science has always taken the institutional features of science as its research tradition’. The principle of knowledge communism embodies the distinctive qualities of science—autonomy and self-governance (Horton, 2003)—and this point has been discussed by many science sociologists. Merton (2000) argued that recognition is the only currency of the scientific circle and that it not only determines the social prestige of scientists but in turn affects their position in the hierarchy of the scientific circle and thus their resource endowment. Through a comparative study of the rankings and number of awards received by the citers and the
cited in physical sciences, the Cole brothers noted that ‘the impact of the hierarchy on the question of who would use a scientific result should be attributed in part to the quality of that result. Prominent scientists are more likely to use the results of prominent scientists because those results are of a higher quality’ (Cole and Cole, 1988).

Communism is also the basis for healthy interactions between scientific and social systems. Storer (1996: 86) described science as a unique exchange system in which ‘the first principle (communalism) encourages people to participate in the exchange activities of a social system and look for goods that are exchanged within that system. Communism serves this function by requiring scientists to present the results of their work before their colleagues’. Therefore, despite the complexity of the applicability and operability of communism and the new requirements for the conduct of the scientific community (PLACE: proprietary, local, authoritarian, commissioned and expert) proposed by Ziman (2002), it must be acknowledged that knowledge communism now serves as an important guide for understanding the social properties of scientific knowledge. The requirements of communism have been internalized as a basic norm for the actions of the scientific community. Communism is not only an institutional constraint on the conduct of the scientific community but also a somewhat idealized objective requirement for the scientific circle. Institutional goals will, to a certain extent, affect or even restrict the behaviour of scientists, and communism is precisely an institutional requirement for realizing the social function of science. In this sense, communism is the theoretical origin of the concept of knowledge sharing, and it also has a profound impact on the scientific evaluation system, the social responsibility of scientists and the social establishment of science.

Although knowledge communism sees the production of scientific knowledge as a non-profit social activity, it does not reject scientists’ demands for recognition and originality. It stresses that, as scientists receive funding from the government, they should give back to society as many scientific knowledge products as possible. The implicit presupposition of such a relatively traditional contractual relationship is based on the maximization of social benefits in the production of scientific knowledge and the conversion of research results. The social function of science is reflected in communism in the way that the scientific community provides scientific knowledge to members of society, and such knowledge can bring more benefits to society. ‘Knowledge in itself is of little value, but shows its value when connected to other things’ (Sarton, 2007: 184). The socialization of knowledge products is a direct manifestation of this principle. The government, which sits between the scientific and social systems, must play a crucial role in this socialization process, as it will determine the level of application of the communism ethos.

Unlike other social products, scientific knowledge can be recognized and acknowledged only when it enters the communication system. ‘Communism has activated a sophisticated system of communication. Research results cannot be counted as scientific unless they are reported, disseminated, shared and finally turned into a public asset through formal publication’ (Ziman, 2002). However, in the actual practice of scientific communication, it is difficult to design and implement operable institutional norms for communism. Merton’s original design implied that ‘the institutional notion that science is part of the public domain is tied to the rule that scientific discoveries should be communicated’ (Merton, 2000). Therefore, in scientific practice, knowledge communism is often associated with the priority of scientific discoveries and the peer-review system. The print journals of the early period constituted a best system to truly align those three elements. However, ‘such a system has only addressed the ownership issue of scientific knowledge in the epistemic sense, but neglected the issue of access to scientific knowledge; that means, it fails to consider how scientific researchers and the public could access scientific knowledge’ (Zhang et al., 2014).

3. Cultural tensions between science and commerce from the perspective of academic capitalism

As the social function of science continues to manifest itself, ‘post-academic science’, ‘post-conventional science’, ‘triple helix’, ‘academic capitalism’ and
other new descriptions that have reconceptualized the relationship between science and society continue to dissolve the ‘ivory tower’ character of science. Academic institutions and commercial organizations move from isolation to integration, and the applied value and economic benefits of scientific knowledge become more prominent. This leapfrogging development of the knowledge economy has provided the background for the rise of academic capitalism. An important feature of a knowledge economy and society is the blurring and blending of the boundary between knowledge and the economy and the growing public recognition of the commercialized operation of scientific knowledge achievements that function as social products. Academic capitalization protects scientists’ economic benefits through intellectual property rights, technology licences, patent protection and other measures, thereby resolving the implicit conflict between the public attributes of academic discoveries and scientists’ private economic interests. In addition to boosting their academic prestige, scientists can also receive higher economic returns by publishing papers, thus giving the dual features of economic benefits and public welfare to universities and research institutions. Gibbons et al. (2011) introduced ‘Mode 1’ and ‘Mode 2’ knowledge production and argued that ‘in Mode 2, the discovery, application and use of knowledge are tightly integrated, and knowledge production has become part of a larger process. This is largely due to an important mechanism: the expansion of the knowledge market and the increasing marketization of science’. Baldini (2006) noted that ‘universities worldwide have become involved in commercial activities’.

In this context, the construction of web databases is taking place. The essence of such endeavours is to construct knowledge resources as tradable social products with the help of web technologies. From the perspective of the tension between science and commerce, knowledge is for the public and for profit. In addition, universities and publishers have completed a preliminary division of work: academic institutions provide publishers with separate scientific papers, while publishers provide academic institutions with systematic and integrated database resources. In this process, publishers have become involved in constructing the public visibility of scientific knowledge and the academic influence of scientists, reinforcing the collective dependence of the scientific community on commercial databases by dividing the hierarchy of journals and calculating their impact factors. Therefore, taking advantage of the huge communicative power and influence of online platforms, publishers have stimulated the scientific community’s demand for cutting-edge academic information and indirectly contributed to constructing scientists’ academic prestige by increasing the public visibility of knowledge products.

The interaction and collision between universities and publishers have become the main features of the commercial operation model for scientific knowledge products. Commercial capital has been invested in science communication and has returned huge profits because of the strong demand from the scientific community for rare academic resources. Commercial interests have achieved monopoly profits mainly through database purchases and single-paper subscriptions. Publishers have chosen different technology-control and marketing strategies to maintain their competitive business advantages. However, the scientific community can access scientific papers only by payment. In other words, scientists have a dual identity as knowledge producers and consumers. This situation has exposed an otherwise implicit conflict between the public interests of society and the private interests of the publishers.

As the prices for access to databases have continued to climb in recent years, high subscription fees have become a heavy burden for many universities and research institutions. Some have even been forced to discontinue their subscriptions to authoritative databases, such as Elsevier (Ding, 2019). Database resources have become an important condition for securing scientists’ knowledge-production capability. The possession of cutting-edge academic information further solidifies the existing hierarchy in the academic circle. Therefore, universities and research institutions that cannot afford to pay for database resources are trapped in a vicious cycle of weak research output and talent recruitment, inviting extensive criticism concerning the involvement of commercial capital in science communication. Moreover, this situation also brings a new risk insofar as knowledge-producing institutions have to deal with converting the property rights of research results under the academic capitalism model. In
other words, ‘the privatization of the common rights of science could lead to a future in which important aspects of scientific knowledge become private property rights and are no longer in public control. This is a regrettable development for scientific and technological progress in the future’ (Schuetze, 2007).

The harm caused by the commercial operation of scientific papers to the interests of the scientific community and the wider public has become a serious social problem.

The combination of knowledge and capital has made it more difficult for the academic system to uphold the meta-value of the perception of free scientific knowledge. If we use field theory to compare knowledge-producing institutions and commercial publishers, we can see that knowledge-producing institutions, such as universities and research institutions, which function as public interest and non-profit organizations, are mostly located in the knowledge field and in clear pursuit of academic culture and values. Commercial publishers, as economic and profit-making organizations, are mostly located in the economic field, and the pursuit of commercial value and monopoly profits is their primary goal. The pursuit of different goals has resulted in irreconcilable conflicts between the two types of organizations during their interactions. In this process, the two fields constantly clash and collide. Publishers have gained control of intellectual capital in the knowledge field by appropriating knowledge products and, in the process, have gradually completed the penetration and integration of the knowledge and the economic fields.

Therefore, the conflict of interests between knowledge-producing institutions, such as universities, and commercial publishing groups in the context of knowledge capitalization originates from their different understandings of intellectual freedom and confidentiality and reflects their different perceptions of the social value of knowledge and the definition of intellectual property rights underlying the monopolization of academic resources. On the issue of the new knowledge divide in the academic circle caused by the monopoly of knowledge resources, the views of the two sides are even more divided, essentially reflecting the conflict between the demand for knowledge communism and the tendency towards academic capitalism. Therefore, in the case of research information and data, the most important thing is to establish a cognitive foundation that brings the two sides closer, because ‘with the development of the digital economy, open sharing of research data has become a necessary public service … but also brings new moral and ethical risks’ (Gu, 2018).

As two important actors with different interests, the scientific community and publishers are constantly balancing and reconciling their interests. This unique and complex relationship of coexistence in contradiction is even clearer now. The root cause of the conflict and the clash between the two sides is, in essence, the inherent conflict between the goals of commercial interests and the research demands of academia. To address this problem, a new network for the distribution of interests needs to be established between heterogeneous actors, such as universities and research institutions, government departments, science organizations, publishers and the public. Therefore, the establishment of a new balance between academic and commercial interests to best utilize the potential functions of different actors in the scientific exchange process is a practical issue that must be resolved in the open-access mode.

4. Coexistence in conflict: The rationality of open access and some reflections

The questions and criticism raised by the academic circle on the communism ethos of science mainly concentrate on the following two aspects. First, the communism claim is overly idealistic because it ignores the economic interests of scientists, and the scientists’ code of conduct proposed by Merton has not been internalized into scientific culture as part of self-awareness. Second, the communism ethos is too macroscopic, and the context for the production and communication of scientific knowledge is often very complex, making it difficult to define whether the communism ethos is violated. Meanwhile, Ziman (2002: 138) argues that it is precisely the emergence of network technologies that has contributed to the realization of the communism norms of scientific knowledge: ‘Networking contributes to communalism, and ICT [information and
communications technology] stimulates and facilitates the traditional practices of collegiate science.’ Ziman also suggests that science has been loaded with more economic and social goals during this period, and innovation cooperation between scientific institutions and industrial enterprises is becoming more vibrant. As a result, scientific knowledge is now being judged by new values defined as proprietary, confidential, target-based and value-loaded. Such a judgement has secured the economic interests of scientists by reaffirming the new social functions of scientific knowledge and, on that basis, generated returns for investors (government and industrial enterprises) in scientific knowledge production, thereby establishing a healthy interaction between the scientific system and other social systems.

The new environment for web-based scientific exchange has paved the way for the construction of a digital database of knowledge resources. As important actors in the process, publishers play an essential role in the classification, standardization and dissemination of knowledge. However, there is no denying that the pursuit of economic profits in commercial operations conflicts with the requirement of sharing that defines scientific communication. Publishers play no part in the production of scientific knowledge. Unlike the protection of the proprietary properties of scientific knowledge in the form of intellectual property rights and technology patents, what publishers have is essentially a monopoly of scientific papers organized on a web-based platform. As scientific knowledge becomes a tradable product, the scientific community faces the double paradox of having to pay for the publication and for the use of scientific papers. Therefore, the real aim of the open-access movement is to break the science blockade established by commercial databases using online platforms. The open-access movement opposes the monopoly of scientific knowledge achieved by abusing the concept of intellectual property protection. It promotes the collaborative production of knowledge, calls for the open sharing of knowledge results and advocates a scientific research paradigm with society-wide involvement. In the open-access mode, knowledge regains its property as public goods, echoing the communism approach that denies the private ownership of knowledge.

From the STS perspective, open access has expanded and upgraded the concept of knowledge communism. It reflects the scientific community’s belief in and demand for public ownership of scientific knowledge and shows the scientific community’s determination to maintain the autonomy and self-governance of scientific knowledge production. The unimpeded dissemination of scientific knowledge is an effective way to maximize its productivity and realize the contractual relationship between the scientific community and society as a whole. ‘Communism is an institutional requirement for the “collective contract” between government and science, and between society and science’ (Li, 2006). The production of scientific knowledge now serves more and more social and even national goals. Kling et al. (2003) argue for examining knowledge within the larger framework of the sociotechnical system. Borgman and Furner (2002) noted that ‘we have witnessed qualitative and quantitative changes in scholarly communication processes in the environment of electronic communication, including complex collaborations and consultations among scientists, the rhetoric and communication of research results, and the construction of scholarly networks’.

Scientists’ desire for priority in scientific discoveries is an important condition driving open access. ‘A system that rewards priority encourages scientists to actively contribute information to the public domain of knowledge, as evidenced by the growing rate and number of publications and the prolonged working hours of scientists, especially those engaged in pioneering research’ (Hong, 2010). Meanwhile, the public’s intense interest in new science and new technology demands the open sharing of scientific knowledge, especially for projects financed by public funds. Open sharing is not only an important condition for knowledge reproduction but also an effective way for open review and even for correcting errors in knowledge. It also provides an important means for building knowledge-production capacity and promoting innovation in scientific knowledge. Open access not only changes the mode of knowledge communication and dissemination but also transforms the relationship between the supply of and demand for knowledge. In this sense, while contributing to the knowledge communism campaign, web technology has also provided
possibilities for breaking the monopoly of knowledge resources. In ‘The global research village’, the OECD (1998) observed that ‘predicting ICT’s impact on the scientific system could be very difficult because technology is rapidly evolving, and its potential and limitations are still not fully understood’.

Today, science communication is a highly complex subject. The establishment of new modes of knowledge acquisition must adequately address and balance the distribution of benefits among different actors. In the early stages, open access was a completely spontaneous act of the scientific community against the monopolization of scientific information. There was no mobilization or guidance from universities, societies, intelligence agencies or governments. As the current situation shows, libraries and governments are the two actors that particularly need to make adjustments. Libraries are an important node in science communication systems, and the implementation of open access will bring significant changes to their traditional functions. ‘The advance of digitization and open access transforms the traditional resource-building function of libraries into a knowledge organization function’ (Chu and Zhao, 2019). Meanwhile, among all the actors, the government is the most likely to play the role of coordinator in the interests of all parties. In the constant alliance-shifting and confrontation among multiple actors, a government-led model of collaborative governance is likely to emerge. In addition, the continuous adjustment of the value claims and risk perceptions of the multiple actors will lead to the creation of a public claim for values, which ‘will be further clarified in the dynamic trade-off between the public and the various stakeholders’ (Liu, 2019). In essence, the policy design and institutional adjustment introduced by the government for promoting open access are intended to create a new balance in the distribution of interests and power among different actors; that is, to coordinate the complex relationship of responsibilities, rights and benefits among different actors in the new situation.

It must be noted that open access, while constructing a new science communication system, also brings with it new social issues, such as the openness and scarcity of scientific information, the distribution of knowledge resources and the efficiency of knowledge production, and the relationship between the hierarchy of the scientific community and the allocation of academic resources. Meanwhile, many questions about the open-access mode remain in the academic circle. For example, some scholars argue that the implementation of open access still looks like a commercial operation, and the more influential journals still charge authors high article-processing fees. Other scholars argue that the drastic simplification of the editorial and review process by open-access journals has lowered the threshold for quality, enabling low-quality academic results to enter the public platform and sacrificing the quality of knowledge. Such a situation not only increases the cost of knowledge screening for scientists but may even mislead the public and provide people with incorrect knowledge. As the current situation suggests, the quality of open-access journals is uneven, and the academic influence and originality of many open-access resources are not high. Such an overly discretionary knowledge-publication mechanism is likely to undermine the rigorousness and truthfulness of research results and even tarnish the academic reputations of researchers; for example, it may have an ‘adverse impact on the credentials of young scholars who have published papers in open access journals’ (Agrawal, 2014).

5. Conclusion

With the advance of information and network technologies, the trend to the digitized, open and community-based production of scientific knowledge has become increasingly evident. Until now, the open-access movement has made notable achievements, and the open-access concept has also produced a visible social impact. However, it is noteworthy that the construction of open resources still faces many urgent social problems regarding publication costs, quality control, assessment mechanisms and public visibility. It is particularly striking that many scholars still tend to submit their best results to more advanced journals to win the recognition of the academic circle, and the attention received by open journals is still far from sufficient.

As the current situation shows, open access is still in the development stage. The construction of open-
access resources varies notably among different countries and disciplines, and promoting the application of the open-access mode remains an arduous task. However, with the growing influence of open access, new modes of deeper knowledge sharing, such as open data and open science, are emerging, providing new opportunities for developing countries, including China, to catch up with cutting-edge science. The interaction between scientific and social systems will become more complex in the future. Providing well-designed policies and institutional safeguards for the open sharing of scientific knowledge has become an important task for the Chinese Government, as it not only concerns the knowledge acquisition and production capacity of the scientific community in China but also presents a strategic choice for enhancing the knowledge innovation capacity of Chinese scientists.

Declaration of conflicting interests
The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding
The authors disclosed receipt of the following financial support for the research, authorship and/or publication of this article: This work was supported by the Major Commissioned Project of Shandong Province on Social Science Planning ‘Research on Building a Strong Province of Science and Technology with Innovation as the Driver’ (grant number 20AWTJ24).

Note
1. STS is a research method, which is clearly critical, that takes science and technology as the research object and analyses the occurrence and development of science and technology and its interaction with society through philosophy, sociology, policy, anthropology and other methods.

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