Neither Market nor Hierarchy or Network: The Emerging Bazaar Governance

Abstract

Despite the growing body of literature describing the open source phenomenon, research has largely focused on the software industry. Drawing on transaction cost economics, we propose that open source projects illustrate a new generic governance structure — which we label bazaar governance — based on a specific legal contract: the open license. We characterize this structure in terms of its strengths and weaknesses and compare it to market, firm and network forms. Low levels of control and weak incentives intensity are distinctive features of bazaar, lending a high uncertainty to governed transactions. However, bazaar governance promotes the openness of open source communities, which can generate strong positive network externalities and subsequent efficiency in cumulative transactions. Our developments offer a potential basis for future research.

Keywords: bazaar governance, governance structure, open source, transaction costs economics

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New forms of relationships between economic agents have appeared in recent years, most strikingly in the computer software industry, and have led to the emergence of communities organized and coordinated around open source products (von Hippel 2001). These communities have benefited greatly from the advent of the Internet, which has enabled members to interact and share resources extensively (Lee and Cole 2003; von Krogh and von Hippel 2003). The most famous example is the Linux operating system, which against the odds has won recognition as a credible competitor to Microsoft and has gained support from a community of several thousands of co-developers and millions of buyers and users worldwide. In the past few years, the concept of open source has begun to be broadly acknowledged in newspapers and business-oriented magazines and on Internet forums, especially as far as information technologies are concerned (DiBona et al. 1999; Raymond 1999; von Hippel 2001; Wayner 2000). Academics too have joined the bandwagon, with the implications of open source generating discussion especially in the fields of economics and management. Topics that have been given particular attention include incentives in open source projects (Lerner and Tirole 2002; Hertel et al. 2003); the public/private-good status of open source products (O'Mahony 2003; von Hippel and von Krogh 2003); business models of open source enterprises (Kuan 2000); a new methodology for innovation (von Hippel 2001; Franke and von Hippel 2003); competition between proprietary and open source software (Dalle and Jullien 2003; McKelvey 2001); how open source developer communities are organized (Raymond 1999; Lee and Cole 2003); and open source as an ideological movement (Stallman 1999). Open source projects have not, however, been envisaged in terms of a generic structure regulating transactions which could be employed in different industries.

Drawing on the idea that open source projects are characterized by a specific contractual framework (an open license), we identify through the lens of transaction cost economics (TCE) a new structure of governance, which we call 'bazaar governance.' Our aim is to identify the main features of this new design, its empirical forms and its potential applications in various settings, as Powell (1990) did for the network.

The paper is organized in four sections. The first briefly retraces the history of open source. The second section explores the institutional framework of open source and introduces the open license. We argue that this particular type of contract is the basis of a specific governance structure. The third section characterizes governance structures in terms of TCE

and supports our proposition that the bazaar constitutes an alternative form of governance. We compare this form with the traditional market, firm, and network forms, and consider the specific characteristics of bazaar governance. The last section explores how bazaar governance is actualized in an industry. We focus especially on mixing other governance forms with bazaar governance, and on bazaar's potential generalization to settings other than software.

1. A Brief History of Open Source

Drawing particularly on Raymond (1999), von Hippel and von Krogh (2003) and West (2003), we trace the history of open source and its recent recognition among managers and academics.

Through the 1960s, the sharing of basic software source code among programmers was commonplace and informal (Lerner and Tirole 2002). The concept of cooperative source-code development across a network, however, was born with the Advanced Research Projects Agency Network (ARPAnet), established in 1969 by the U.S. Department of Defense. By the beginning of the 1980s, efforts to formalize this informal development methodology had begun to appear. In 1985, Richard Stallman created the Free Software Foundation and designed the GNU General Public License (GPL) in response to MIT's decision to license some of the source code developed by its developers to commercial firms. The GPL authorizes anyone to use and modify the software, as long as he or she agrees to keep the source code freely available and not to impose further restrictions on other agents, distributing it or any software derived from it only under the continued terms of this open license.

In 1991, Linus Torvalds released the core source code for the Linux operating system in an Internet newsgroup, looking for improvements. But it was not until Internet access became widespread that free software really bloomed. Because 'free' software 'might understandably have an ominous ring to the ears of business people' (von Hippel and von Krogh 2003: 210), the term 'open source' was coined to emphasize the practical benefits of open licensing and to extend most of the free software principles to for-profit organizations (Raymond 1999). Open source gained public recognition in 1998, when Netscape decided to make its Web browser an open source product (Mozilla) and IBM adopted the Apache Web server, another prominent open source product. Interactions between open source projects and private companies soon became commonplace, demonstrating that open source is not only an ideological movement but also a sustainable business model.

It is important to understand that what distinguishes free and open source software from traditional arrangements is a matter of freedom, not price (Dalle and Jullien 2003). Free and open source software are not necessarily free of charge, and can be bought and sold. For instance, for-profit companies are now selling Linux through traditional retail stores and providing support services for this type of product, as even freely distributed products can generate revenues in complementary areas including packaging, consultancy, maintenance, updating and training (the Red Hat business model is based on supplying applications and technical support to Linux users).

The open source movement has reached a critical mass. There are now thousands of open source projects worldwide (by January 6, 2005, sourceforge.net had registered 93,303 projects), a few of which have resulted in products that have become market leaders or credible challengers in market niches. For instance, Linux is currently the World Wide Web's leading operating system, running 31% of web servers, versus 24% for Windows (Lee and Cole 2003). Prominent actors in IT industries now take open source software into account when formulating and implementing their market strategies (IBM, Hewlett Packard, Compaq, Dell, Intel, Oracle, and Sybase have all made major commitments to Linux). To summarize, open source projects are no longer tangential to the world of business, justifying their interest to researchers.

2. Introducing Bazaar Governance

As Williamson (1985, 1991) has shown, specific contracts define and provide support for each generic form of governance. Williamson does not exclude the possibility of identifying arrangements other than market, firm or hybrid (for example, he evokes the 'bureau'). We argue that open licenses support a new form of governance; a new generic structure which we name 'bazaar governance'.

Why have we coined this term? First, because Eric Raymond, a founder of the open source movement, uses the image of a bazaar to describe how open source projects function. Unlike the usual approach to building software 'like cathedrals, carefully crafted by individual wizards or small bands of mages working in splendid isolation,' Raymond notes that Linux is more like 'a great babbling bazaar of differing agendas and approaches' (1999: 30). Second, the bazaar as an oriental market refers to a specific organization of economic transactions with chaotic appearance, which enables vendors to propose products varying greatly in quality (Geertz 1978). These features are congruent with our development of bazaar governance.

To support our arguments, we first examine the specific contractual framework of bazaar governance: the open license. In a second section, we characterize bazaar as a governance structure.

2.1. A New Kind of Contract: The Open License

A governance structure is an institutional framework regulating transactions between actors. In the case of free software and open source projects, this regulation is embodied in a specific and generic type of contract, the open license. As noted by von Hippel and von Krogh (2003: 210), the term 'open source' in fact 'denotes only the type of license under which it is made available.' Indeed, 'licenses are the most important institution in the governance structure of open source projects' (Bonaccorsi and Rossi 2003: 1248). The open license is 'an institution which enables the emergence of free software community' (Dalle and Jullien 2003: 2) and its governance (O'Mahony 2003: 1179).

The GNU General Public License was the first formal open license enacted, but there are now almost as many open licenses as free software or open source projects[1]. Some of these are tacit while others are formal. However, to various degrees these contracts all promote a specific application of property rights. The basic idea of these contracts is to use copyright law to guarantee that users will benefit from certain basic rights. The simple fact of possessing a product under an open license grants the right to use it, to study its source code, to modify it, and to distribute modified or unmodified versions, whether freely or not (Free Software Foundation)[2]. Moreover, the open license ensures that no one can appropriate the source code of a product, distinguishing free software and open source principles from proprietary owned products (West 2003). Incentives to disclose information and knowledge would be weakened if users were able to 'appropriate the associated reward, be it through profit or through reputation' (Dalle and Jullien 2003: 4).

Beyond this shared legal basis, there is a distinction between free and open source projects (Bonaccorsi and Rossi 2003; von Krogh and von Hippel 2003; West 2003). Free software licenses prohibit ex-post appropriation of any improvements or derivative works, whereas open source licenses allow the appropriation of such contributions. The General Public License, under which 80% of the free software or open source projects are released, is

[1] 'In fact, providing that the fundamental open source conditions are respected (full access to the source code, full software usability, freedom of modification and redistribution of software), anyone can elaborate his own open source license' (Bonaccorsi and Rossi 2003: 1249).

[2] The entire texts of several licenses are available on http://www.opensource.org/licenses/index.html. While most of these licenses concern the software industry, other sectors are also represented. An example is the Academic Free License.

a free software license. As noted by Stallman (1999), free software principles prevent companies from making minor improvements to the software and then using it to attract consumers to their non-free commercial products. Any improvements or derivative works must also be distributed as free software. Indeed, free software guarantees that the product, as a whole, will always remain free (Dalle and Jullien 2003).

In contrast, open source projects 'do not impose any such restrictions, allowing individuals or firms to customize and combine open source software as they desired' (West 2003: 1266). Open source licenses allow anybody to retain property rights on his or her own improvements to the product, providing that the source code remains freely available.

Open source is commonly used to refer to both free and open source software (von Krogh and von Hippel 2003: 1151). Following this practice, in this paper we use *open source* to subsume both free software licenses and open source licenses.

An unusual characteristic of open licenses is the way it links two different kinds of agents together. The open license enables the owner of an asset to allow other agents to use, copy, modify, improve or distribute that asset. In the following discussion we use the term *sponsor* to denote an asset-holder who originally attaches an open license to this asset, establishing it as an open source project. We use *adopters* to describe agents who have subsequently obtained the product. Some adopters become contributors, improving the product or developing derivative products. Together, sponsors and adopters (whether they are contributors or not) constitute a community (von Hippel 2001). In the open license contractual framework, the sponsor cannot choose or select adopters, and any agent may become an adopter and eventually a contributor.

2.2. Characterizing Bazaar as a Governance Structure

This paper argues that bazaar governance can justifiably claim to be a new kind of governance structure: that it is an original means of organizing exchanges that cannot be subsumed by other structures. In this section we describe the concept of governance structure and what it encompasses in TCE. We then discuss how the governance construct applies to open source communities.

The concept of governance structure is central to TCE. Coase (1937) emphasized that transactions may be organized through a market or within a firm, and that each of these governance structures displays specific functioning costs. Williamson projects to study these structures in a comparative institutional way. The core of Williamson's theoretical development is that transactions entail uncertainty about their outcome because of the

bounded rationality and opportunism of agents, and that, consequently, exchanges may be accompanied by negotiating and monitoring costs. To overcome this uncertainty, and as a means of reducing transaction costs, agents implement a governance structure defined by Williamson as 'the explicit or implicit contractual framework within which a transaction is located' (Williamson 1981: 1544). This governance structure 'is a means by which to infuse order in a relation where potential conflict threatens to undo or upset opportunities to realize mutual gains' (Williamson 1999: 1090). According to TCE, the choice of governance structure should be aligned with the characteristics of transactions, especially the specific investments required by transactions. Economic agents enjoy superior performance if transactions are properly aligned with a corresponding governance structure (Silverman et al. 1997).

Market, hierarchical, or hybrid forms of organization are discrete structural alternatives for any transaction. Each is supported by a different contract law (Williamson 1991: 271–276). Markets are supported by classical contract law, by which the identities of the transacting parties are irrelevant and dependence slight. In market, strict adherence to contractual terms prevails and courts are appealed to in case of dispute. Hybrid organizations are supported by neoclassical contracts in which parties are bilaterally dependent but remain autonomous and their identities matter. Long-term contracts promote adaptation to absorb disturbances. They favor arbitration over litigation but do not exclude legal recourse. These hybrids encompass network forms whose specific characteristics allow them to be considered as discrete rather than residual structures (Powell 1990). Hierarchy is supported by employment contracts and is grounded on the principle of forbearance. As noted by Williamson, 'hierarchy is its own court of ultimate appeal' (Williamson 1991: 274). The parties in a dispute resolve their differences internally, drawing on fiat (authority) that cannot be exercised in market. Routines and hierarchical structures ensure communication between agents within a firm (March and Simon 1958), and administrative controls provide greater powers to monitor and discipline agents than a market structure permits (Powell 1990).

Beyond the contractual framework, each governance structure also employs different means to regulate adaptability in transactions and to ensure coordination, enabling the various parties 'to work through their differences and get on with the job' (Williamson 1999: 1090). In TCE, this coordination is characterized by a trade-off between incentive and control intensities (Williamson 1991). The intensity of incentives regulates how motivated agents are to be effective in their production functions, whereas control intensity refers to the capacity of a governance structure to contain opportunistic behaviors and to align the behavior of

different parties in a transaction. These mechanisms allow the different structures to be efficient under particular conditions. Market displays a high level of incentives and a weak level of controls, exactly the opposite of hierarchy. Hybrid forms are at an intermediate position on both dimensions.

To summarize: any governance structure is grounded in a contractual framework but is also characterized by control and incentive mechanisms that enable it to govern transactions. On the basis of this definition, can bazaar justifiably claim to be a new kind of governance structure?

First of all, in the case of open source communities a specific and original contract, the open license, assures participants that nobody will appropriate the core of the open source product. Without this safeguard, agents would face a high level of potential opportunism and would probably not participate in the community (Dalle and Jullien 2003). This distinctive contractual framework differs from better-known contractual forms. Agents traditionally take advantage of their assets in a variety of ways. They might be valorized within firms, through secrecy or the ownership of patents or copyrights (Granstrand 1999). An agent may also exchange its property rights on the market (Alchian and Demsetz 1973) or cooperate within a network using traditional licensing or cross-licensing agreements (Granstrand 1999; Nickerson 1996). The open license entails a property-rights regime that differs fundamentally from the contracts underlying traditional forms of governance. Bazaar could claim to be a specific structure of governance on the basis of its novel contractual framework. While this condition is not sufficient, it is necessary.

Second, it is important to acknowledge that transactions are actually governed in open source communities and that exchanges between parties do occur. Transactions occur whenever ‘a good or service is transferred across a technologically separable interface. One stage of processing or assembly activity terminates and another begins’ (Williamson 1981: 1544). As O’Mahony points out, open source ‘connotes the idea of transactions from one to another’ (2003: 1189) — for example, when software developers add new developments in the Linux community. Linux developers carry out two important functions, each of which involves numerous transactions: quality assurance (for example, by testing and correcting software or reporting bugs) and innovation (such as creating new features or writing new patches) (Lee and Cole 2003: 637). Beyond the work of the developers who are at the heart of these software projects, users in a community can voluntarily provide answers to questions posed by others users, enabling them to assure the delivery of high-quality products, as with the Apache Help Usenet forum (Lakhani and von Hippel 2003: 923–924). What is interesting

in these examples is that they demonstrate that bazaar can organize similar kinds of transactions as other structures of governance do. In the case of computer software, a company could otherwise employ its own team of developers to produce new developments (via hierarchy), buy software to meet its needs (via market), or establish a long-term subcontract with a supplier to maintain a help desk or maintenance services (via network). The bazaar is able to govern transactions that could be governed through other mechanisms and is not restricted to governing specific exchanges. This suggests that bazaar can profess to be an institutional alternative to other governance structures.

Third, bazaar governance occupies a distinctive position along the control and incentives dimensions. Several empirical studies of software communities have found that open source mechanisms give rise to low levels of both controls and incentives intensities, a novel combination (Ghosh and Prakash 2000; McKelvey 2001; Hertel et al. 2003; Lakhani and von Hippel 2003; Lee and Cole 2003)[3]. Control mechanisms are weakened by the absence of employment contracts through which to enforce decisions — in general, no one in the project is obliged to perform any particular task (Bonaccorsi and Rossi 2003: 1247). As von Hippel and von Krogh (2003: 218) argue: 'one of the norms clearly expressed in the hacker community is that work cannot be mandated and enforced by a leader.' Social norms such as this, or the norms promoting the citation of authors and the sharing of knowledge, do emerge in the community (Lee and Cole 2003), but they do not constitute strong social control over individuals. These norms cannot give anyone the authority to allocate resources to specific tasks, with the result that jobs will be neglected when there are no volunteers (Lakhani and von Hippel 2003).

As far as the incentives for transacting parties are concerned, they also appear weak. A number of authors have commented on the skewed distribution of contributions in open source communities. Of the numerous actors involved in an open source community, few make real contributions to the project, and free-riding prevails (von Hippel and von Krogh 2003). For instance, in the Apache community, 'approximately 50% of the answers on the system were provided by the 100 most prolific providers (2% of all providers)' (Lakhani and von Hippel 2003: 931). A survey of open source communities conducted in 2000 included 12,000 developers involved in open source projects and found that the top 10% were credited with more than 70% of the code (Ghosh and Prakash 2000). These observations result from the voluntary involvement of parties in a community and the intrinsic rewards they can earn

[3] Some communities do evolve towards mixing of forms, increasing control and/or incentives levels — this point is discussed in the last section of this paper.

by participating in a project. Raymond (1999) notes that successful contributors to an open source community may benefit from an enhanced reputation among their peers, increased attention, and better cooperation from others. Although these reputational or signaling effects (Lerner and Tirole 2002) can constitute compelling incentives, they concern only a very narrow portion of a community (Dalle and Jullien 2003). The number of hours such contributors dedicate has no correlation with the strength of these effects (Hertel et al. 2003)[4].

Displaying low levels of control and incentives (Table 1), bazaar governance results in a paradoxical trade-off that contrasts with the counterbalancing characteristics of other governance structures. But this apparently unfavorable combination does not always equate to an overall inefficiency of this governance structure. As we discuss later in this paper, efficiency can emerge from the aggregation of multiple transactions.

In the next section we adopt a comparative approach to examine the bazaar governance structure alongside other forms of governance.

Table 1. A comparison of governance structures

	Market	**Hierarchy**	**Network**	**Bazaar**
Contractual framework	Classical contract	Employment contract	Neoclassical contract	Open license contract
Incentives intensity	High	Low	Intermediate	Low
Control intensity	Low	High	Intermediate	Low

3. Bazaar Governance Compared with other Structures

3.1. A Comparative Approach to Governance Structures

The different governance structures identified by the literature can be considered as stylized forms of means to coordinate exchanges. They do not perfectly describe economic reality, but are useful in comparing the different means of exchange and help us to grasp the diversity of economic arrangements (Powell 1990: 301). Comparing the bazaar with other governance structures allows us to highlight the empirical particularities of this governance structure.

The empirical distinctions between bazaar, market and hierarchy are quite obvious. As we pointed out in the preceding section, open source communities do not rely on employment contracts and so are unable to be governed by formal authority as is the case in a hierarchy. In

[4] Lakhani and von Hippel noted, however, that 'enhancements to reputation as an incentive was ranked significantly lower in both surveys — possibly due to self-reporting bias on the part of respondents' (2003: 927).

the bazaar, the absence of any hierarchical authority structure is the rule (von Hippel and von Krogh 2003) and transactions occur in a community in which boundaries are not clearly defined. This does not mean that the bazaar is always in a state of anarchy and relies only on self-regulation. Indeed, social norms and administrative rules can emerge in these communities (Lee and Cole 2003) — for example, to organize peer review or to control 'the privilege of adding to the authorized code' (von Hippel and von Krogh 2003: 211). But the chief difference between bazaar and hierarchy remains the fact that no formal fiat can enforce decisions within the bazaar.

The differences between bazaar and market are also salient. First, as access to the source code is made public and free, price, the major communication mechanism in market (Powell 1990), is not a coordination mechanism that governs exchanges in bazaar. Second, for volunteers in open source communities, potential extrinsic rewards (improving job and career prospects through prestige and visibility in projects) coexist with strong intrinsic motivations (fun, intellectual gratification, altruistic fulfillment, the pleasure of aesthetic or creative endeavor) that can be more compelling (Bonaccorssi and Rossi 2003; Hertel et al. 2003; O'Mahony 2003). The coordination derived from the self-interest of agents in the pure market form (Powell 1990) does not correlate with the individual motivations in the bazaar. This involves that the level of incentives intensity in this new governance structure is weak.

Another difference between bazaar and both market and hierarchy relates to the social roles endorsed by agents. In market, sellers and customers are clearly distinguished. Similarly, hierarchy involves defined work roles. However, in open source communities, users and producers are potentially the same agents, giving this governance structure a high level of local adaptation (Kuan 2000; Franke and von Hippel 2003). These patent differences between bazaar and both market and hierarchy produce a clear demarcation between these forms. They entail that, as it is grounded on radically different mechanisms for governing transactions, bazaar governance cannot be assimilated to nor derived from these two forms.

The bazaar could be assimilated at first glance with the most recently recognized governance structure; the network identified by Powell (1990). The term *community* (von Hippel 2001) favors this assimilation and produces an impression of actors with interpersonal relations, interacting frequently and exchanging various and rich information. Indeed — and despite the eclecticism of the theoretical field with regard to networks (Baker and Faulkner 2002) — in network, mutual dependence, strong personal relationships, and reputation are salient dimensions that preclude agents from pursuing their own interests exclusively (Powell 1990). These long-term and embedded relations insure a better coordination than price

mechanisms and help to solve unexpected problems as they arise (e.g. Uzzi 1997; Dyer 1997). What is more, in network, reciprocity is the basis for a medium intensity of incentives, and social controls similarly promote a medium intensity of control.

However, several fundamental differences distinguish bazaar and network. These differences concern especially the kinds of relations that operate between agents. First, the identities of the interacting agents in bazaar does not matter, whereas network supposes strong ties where great importance is given to the identity of agents and to their previous interactions. For instance, Krishnamurthy's empirical study (2002) of the top 100 mature open source software projects found that most programs did not generate a lot of discussion among community members. Bazaar is constituted by a great number of agents who do not know each other, even though a small number of well-known agents can emerge (for example, a project's founding fathers, such as Linus Torvalds). The identity of agents is not, then, the motor of the open source community. Lakhani and von Hippel illustrate this point when they find that 'nearly 97% of the information providers reported that they did not know the individual they were helping' (2003: 938). This anonymity means that the norm of direct reciprocity is not the rule in bazaar. Individuals propose new developments and provide debugging services or answers on forums to others who they do not know personally. A second major difference between network and bazaar concerns the selection of members in an open source community[5]. Bazaar presents virtually no selection process at all, since nobody can forbid access to an open source community and no one can claim private ownership of property rights, resulting in a principle of non-excludability (von Hippel and von Krogh 2003). This is why bazaar produces free-riding. Although a network displays a certain permeability of its boundaries, because of the importance of interdependent relations its members are few and they are selected. Access to the network is restricted because each tie calls for repeated exchanges over a period of time and strong investments in these relationships are required of members (Powell 1990; Uzzi 1997; Baker and Faulkner 2002). Actors in the network are generally selected according to their strengths, implying that the performance of members is dependent on their partners (Gulati et al. 2002). This is not the case in an open source community, where no one is asked to present a set of characteristics to be accepted. Members may be 'passive' users or 'active' developers. In bazaar governance, membership is open (Lee and Cole 2003) and no selection of parties can be employed.

[5] This is also a major distinction between bazaar and hierarchies, who select their members, and market, in which contracting parties are selected.

These two differences (anonymity and the absence of any selection process) from network are radical. The essence of network lies in the types of relations developed among members (Powell 1990). Because strong ties are not encountered in bazaar, we argue that bazaar cannot be considered to be just a special form of network.

Finally, a major difference between bazaar and other governance structures concerns ownership of the source code. Whereas market, hierarchy and network promote the control of assets through property rights, whether individually or conjointly, the open source license — the primary institutional mechanism of this governance structure — promotes openness and prevents the source code from being appropriated. The fact that the source code cannot be owned appears to be another distinctive characteristic of the bazaar as a governance structure.

These clear differences between bazaar and other governance structures (Table 2) enable us to conclude that bazaar is neither market nor hierarchy or network but a governance structure in its own right. This clear delimitation does not preclude agents from alternating among these generic structures to regulate their transactions. There may be strong personal ties between the founding fathers of an open source project, and some members of open source communities are in fact employees of firms, as firms might use open source software to develop products or services that they then sell on the market. These situations demonstrate that agents may transact through bazaar governance but also exchange through transactions regulated by other forms of governance.

Table 2. The major differences between bazaar and other governance structures

Bazaar compared with Market	**Bazaar compared with Hierarchy**	**Bazaar compared with Network**
No price mechanism to coordinate actors	No formal hierarchical line of authority	Identity does not matter
No definitive delimitation of roles between producer and user (supply and demand are intertwined)	No enforced work roles	No restriction to access
No selection of contracting parties	No selection of members	Non-excludability (Free-riding cannot be avoided)
Source code cannot be appropriated	Source code cannot be appropriated	Source code cannot be appropriated

3.2. Specific characteristics of bazaar governance

Our discussion suggests that bazaar governance contrasts with other governance structures. The distinctive configuration we find with the bazaar (a low intensity of incentives and weak control) contributes to the specific characteristics of this form of governance and, particularly, to its considerable residual uncertainty.

For several reasons, we argue that the bazaar is the most uncertain generic governance structure for agents transacting within it. First, a sponsor initially faces uncertainty with regards to the occurrence of any transactions at all with adopters. A sponsor might propose an open-source product but fail to generate interest among potential adopters, and if nobody is interested in an open-source project 'it can just as easily die out or run into a dead-end' (McKelvey 2001: 225). Consequently, the sponsor endures more uncertainty than do late adopters. Second, even if the sponsor manages to induce adoption and transactions do occur there may be a temporal gap between the release of the open license and the commencement of a body of transactions with adopters. Both sponsor and early adopters face uncertainty concerning the entry of future adopters into the open source community. Third, in most open source projects only a few adopters become contributors, making improvements or developing derivative works. Fourth, the nature of an adopter's contribution is not predetermined. Raymond (1999) notes that, in the absence of fiat or formal division of labor, Linux developers pick and choose what they want to work on. This is echoed by Bonaccorsi and Rossi (2003: 1247): 'in general, no one in the project is forced to perform a particular task, but agents choose freely to focus on problems that they think to best fit their own interest and capabilities … When no one volunteers, the job is neglected.' Not only are tasks not appointed, in many open source projects most of the pending tasks are carried out by several contributors at once — 'the efficiency of product development seems to be rather low because 77% of the contributions appear to be wasted' (Lee and Cole 2003: 644). Finally, even if the transaction conforms to the sponsor's or another adopter's expectations, there remains uncertainty about the quality of the contributors' production, as the open license does not prescribe any level of quality. As we noted above, under bazaar governance, incentive intensity is low and controls few, with the result that in an open-source project 'quality may vary from excellent to terrible' (McKelvey 2001: 221).

The Apache user forum illustrates the strong uncertainty faced in bazaar governance. The community functions as follows: 'an Apache user with a question "posts" it on the appropriate Usenet discussion forum. Any interested user can read both the questions and answers that have been posted, and can provide answers or add to the discussion if he or she wishes to do

so' (Lakhani and von Hippel 2003: 925). As contribution to the project is voluntary, the uncertainty faced by adopters posting a question is strong. In fact, 'participation in the Apache Usenet help forum is small relative to the number of sites … using Apache' (Lakhani and von Hippel 2003: 930–931), and about a quarter of the questions posted on the Apache discussion forum never receive any replies. Moreover, the contributions that are made follow a skewed distribution, as we have discussed above.

Taking only the features we have cited into account (weak incentives and control intensity, and a sizeable degree of uncertainty about transactions), bazaar governance seems far less attractive than other forms of organization. However, as Williamson recognizes, each governance structure has its own strengths and weaknesses. Bazaar draws its efficiency from three particular mechanisms.

The first lies in the sweeping economies of transaction and production costs that an open source project benefits from. According to TCE, the choice of organizational form depends on minimizing the sum of production and transaction costs (Williamson 1979: 245). Within bazaar, the existence of a unique contract shared by the entire community (the open license) permits an economy of transaction costs that brings agents together around the open source product. What is more, non-monetary rewards may strongly reduce or even nullify production costs for some transactions. For example, the debugging of Linux is largely due to voluntary programmers, allowing Linux to develop a product at very low cost.

A second mechanism counterbalances the high level of uncertainty in the bazaar. The open source principle does not allow the sponsor or other users to select new adopters for transactions. As there is no selection process to enter the community, the number of adopters is potentially very high. This contrasts with firm, market and network forms of governance in which agents are scrutinized and selected before any production operation begins. Moreover, as Bonaccorsi and Rossi (2003) point out, within the framework of the open license several contributors might be carrying out the same production operation at the same time — they are limited only by their capabilities. This potential multiplicity of transactions provides an opportunity for an agent to anticipate production he expects to be accomplished by another contributor. Linus Torvalds was originally hoping for transactions such as 'improving the operating system' to supply a credible alternative to proprietary operating systems. Torvalds adopted the open source principle, which favored the emergence of a programmer community, and by doing so achieved the improvements to his operating system that he was looking for. But other kinds of transactions, not envisaged in the initial project, rapidly appeared. Numerous applications have now been written for Linux or have been made

compatible with the operating system; among these are device drivers that enable Linux to run on a wide variety of hardware systems (McKelvey 2001). Other adopters realized valuable transactions in 'testing' various applications or the operating system itself.

The third mechanism that adds to the efficiency of the bazaar is rooted in the cumulative and mutually beneficial effects that characterize communities. Such effects prevail in bazaar governance, as an agent transacting through the open license commits herself to keep her own production freely available (at least in free software) to the rest of the community (Lerner and Tirole 2002). Due to the viral characteristic of free licenses, this cumulative and mutual effect is more prominent in free software than in open source projects. Bazaar governance gives adopters free access to a major part of the production realized previously by contributors to the community. The upshot is that the utility of adopters is tightly correlated to the number of previous transactions that have taken place in that community, as each transaction gives the user free access, under the same open license, to all products freely released in that community. Bonaccorsi and Rossi (2003: 1253) summarize this specific characteristic of bazaar governance as follows: 'a positive network externality effect is also in place. This is due to the possibility for adopters to benefit from a legitimate access to a large pool of usable software tools, whose value is proportional to the number of adopters of [the] open source software.' The bazaar in this way reinforces positive network externalities, because the utility of each agent increases as a function of the number of transactions that have occurred (Farrell and Saloner 1986) and the number of potential adopters who will transact (Katz and Shapiro 1992). Although network externalities may occur whatever the governance structure, a new adopter benefits from the cumulative effect of transactions within the bazaar.

These three mechanisms show why it is necessary to move from the single-transaction unit of analysis put forward in TCE to a consideration of the cumulative effect of transactions. This point is analogous to recent developments that emphasize the transactional interdependencies of governance choice (Argyres and Liebeskind 1999). Without taking this level of analysis into account, bazaar governance will inevitably be seen as inefficient, despite its successes in real life.

The preceding arguments suggest that the weak incentives and control intensity and the uncertainty that prevails in the bazaar are counterbalanced by three strong mechanisms: reduced transaction and production costs; a potentially high number of contributors capable of producing an output; and network externalities related to the number of improvements or derivative works released by and freely available to community members. Paradoxically, these strengths are drawn from the weaknesses of this governance structure, and especially

from the absence of selection processes to determine transacting agents. For example, the weakness of incentives and control mechanisms accounts for its appeal to a great number of agents who may contribute to production, which in turn amplifies the number of transactions and the subsequent network externalities.

4. Actualizing Bazaar Governance

4.1. Mixing Forms

Moving beyond stylized structures, in practice governance structures are often intricate and display a mixture of forms. Powell (1990) demonstrates how the drawbacks of one governance structure can be offset by mixing in elements from other governance forms. In bazaar too, agents may try to influence and change certain characteristics of the structure to reduce some of its weaknesses or to shape it to their needs. For instance, as individual adopters have no predefined role within the community, it is not uncommon to find several agents working on the same task. Faced with this situation, agents may be prompted to introduce hierarchy mechanisms into bazaar governance to increase control.

Three mixing forms in particular are emerging as potential evolutions in the bazaar: an informal hierarchy may develop within a community; certain agents may develop strong ties with each other, evolving toward a network; or some agents may try to copyright their improvements or derivative works. These three evolutions lead respectively to bazaar-firm, bazaar-network and bazaar-market hybrids.

Several authors have drawn attention to the fact that open source communities tend to present certain characteristics of a hierarchy. For example, Linux's ongoing success arguably lies in the quasi-hierarchical management of Linus Torvalds and his 'lieutenants.' West notes that 'in analyzing the "bazaar" archetype for the Linux project, one must recognize the ongoing de facto leadership and control exerted by founder Linus Torvalds' (2003: 1269). The Apache community too presents a kind of centralization with the Apache Development Group, a committee of volunteers that guides the further development and extension of the software (Lakhani and von Hippel 2003). Lee and Cole (2003) also point to the existence in some open source projects of a project leader and 'maintainers' who select the improvements that are to become official. The hierarchization of these worldwide communities is a result of a need to determine which improvements will or will not be incorporated into the product's main architecture (McKelvey 2001). It reduces competition and limits the explosion of transaction costs as the number of adopters and transactions increases. It seems that, to

preserve its efficiency, an extended open source community has to reintegrate fiat mechanisms.

Bazaar governance may also evolve towards a mixing form incorporating network mechanisms. Indeed, some open source projects may be partially coordinated through network governance from the early stages. Bonaccorsi and Rossi (2003) note that the sponsor of an open source project might approach friends or well-known colleagues to contribute to the project before recruiting further afield, drawing on the interpersonal relationships that characterize network governance. Partnerships may also later emerge between other members of the community who develop strong personal ties. The emergence of such ties among agents reduces the uncertainty associated with bazaar governance. It enables a small committee to form that can generate improvements and derivative works and initiate the community.

In taking the open source concept beyond Stallman's free software principles, agents have been given the possibility of copyrighting their own improvements or derivative works as long as they continue to ensure that the source code of the product remains freely available for everybody. Moving from the pure bazaar governance enacted by the General Public License, open source mechanisms are appearing in mixed forms that reintroduce market into bazaar governance to promote its adoption in business settings. This mixture of bazaar and market results in 'a more business-friendly concept of collaborative software development' (West 2003: 1265) that renders open source a more viable business model than free software (Kuan 2000).

4.2. Generalization of Bazaar Governance

The question of bazaar governance's potential for generalization is particularly important. Some authors conjecture that this form of organization "has only limited potential applications outside of the software industry" (Dalle and Jullien 2003: 3). If this structure was only relevant in the context of software development it would be of limited interest to researchers and practitioners. To espouse a form of governance or put it into operation are largely cognitively and institutionally driven processes (Roberts and Greenwood 1997). Evaluation and adoption of such structures are biased in favor of familiar, well-established designs with high levels of cognitive legitimacy. As bazaar governance is an extremely recent development that has gained recognition only in the last few years, its propagation is hampered by its present weak distribution. Under these conditions, it is not surprising that both researchers and practitioners find (or think) it difficult to generalize this structure beyond the software industry.

Several factors can help us imagine how this structure could be applied outside the software industry. Most importantly, bazaar governance appears particularly well-suited to information goods. These are costly to produce but cheap to reproduce, generating no or few economies of scale in manufacturing (Shapiro and Varian 1999; von Hippel and von Krogh 2003). Consequently, from a comparative approach, we can argue that production of physical products that can benefit from economies of scale will be less efficient under a bazaar structure, which is characterized by distributed production capacities, even if transaction costs and distribution costs can be lowered through IT. Moreover, bazaar governance appears well-suited when information can be codified, that is, when it is explicit rather than tacit (Dalle and Jullien 2003; Lee and Cole 2003). Codification enables the cumulative effects that are indispensable in developing and improving information goods. With codified knowledge, each new participant can understand the product and its parts, and potentially add new functions or developments. The importance of this characteristic lies in its ability to enable communication and continued contacts among actors who otherwise do not share the strong ties that typically operate within R&D teams in which the tacit dimension of knowledge is critical (Nonaka and Takeuchi 1995). Codification also enables inter-operability among a product's multiple constituents, including further potential developments, which is a vital consideration in the context of information goods (Shapiro and Varian 1999).

These characteristics obviously apply to the software industry, where they have led to the development of open source communities such as Linux. However, they can also apply to other settings and communities. For instance, the scientific community is generally organized and governed by very similar principles, even though it evokes no explicit legal contract like the open license[6]. More generally, structures and processes that remain implicit and informal in the scientific community are explicit and partly formalized in open source software communities (Glaser 2003). Researchers contribute to common goods — theories — that can be assimilated to information goods. They make their reasoning and hypotheses explicit to foster further developments and enable research efforts and results to be cumulative. Scientific communities also display a skewed distribution of contributions, as a small number of researchers and developers produce a large part of the contributions (Glaser 2003). Every participant is free to take a theory and try to develop it in the direction he or she favors, although there are selection mechanisms in the form of peer reviews. Finally, actors are continually entering or exiting the scientific community, where — apart from several 'stars'

[6] According to TCE, contracts can be explicit or implicit.

or within personal networks — anonymity prevails and non-excludability is the rule. This brief description of public research does not discount the fact that results can sometimes be appropriated by patents, or that research activity can be regulated through other governance structures. For instance, a company might sell a technological development to others (market); grant technological licenses or establish joint ventures (network); or build up an integrated R&D department (firm).

Another example can be found in the tabletop roleplaying game industry, whose products are in the form of books (Lecocq and Demil 2002). In 2000, the American leader of this sector, Wizards of the Coast, released a new set of rules for its famous game, Dungeons & Dragons, under terms based on the open license contract and inspired directly by the example of Linux. All actors in the sector (whether professional editors or individual users) can now use and modify parts of these rules and incorporate them into their own products, which can subsequently be redistributed, for profit or not. As in the research community, membership is open and members cannot be selected by the sponsor of this open source product. As in the software industry, actors can only be excluded if they do not respect the terms of the contract. Dozens of editors have taken advantage of this opportunity, with the result that the sector's products have become far more standardized than they were when proprietary standards prevailed. These products are now compatible and complementary, boosting the sector's global sales.

Both of these examples, the scientific community and the tabletop roleplaying game industry, concern information goods and codified knowledge, consistent with our preceding arguments. What is more, the actors within these communities are not bound by employment contracts, so there is no hierarchy. Unlike a network, both involve such a great number of participants that each actor can only know a very narrow part of the entire community. In contrast with network, too, selection processes are weak. And finally, participation in these communities is not directly driven by price coordination, excluding any assimilation with market.

In conclusion, bazaar governance seems to have been effectively implemented in settings other than the software industry, but appears particularly efficient for information goods incorporating codified knowledge[7]. Other sectors are not theoretically excluded, but where

[7] We find recently several other anecdotic examples of bazaar implementation in various settings involving information goods, far from software. For instance, an Open Cola is under General Public License and displays freely the recipe for cola, allowing anybody to use, modify and redistribute this recipe; an Open Audio License allows musicians to copy, rework, perform and distribute music released under this license; an encyclopedia (Wikipedia) is also proposed under open source (New Scientist, July 1st, 2002).

these conditions are not met this governance structure will be probably be at a disadvantage compared to other structures.

Conclusion

This article is, to a certain extent, speculative, as it concerns a developing phenomenon — the open source — on which empirical academic research is sparse. We argue that this puzzling phenomenon can be conceptualized as the emergence of a new governance structure spurred by the institutional creativity of agents and propagated by the Internet. As Williamson himself recently recognized (2004), the economics of governance is a work in progress that should go beyond the traditional archetypical structures (market, hierarchy, hybrids). Bazaar governance is, then, a potential candidate for analysis within a TCE framework. We have theorized bazaar governance through the lens of TCE because it allows us to construct a comparative institutional framework and provides familiar concepts with which to describe a governance structure. As in TCE, this new governance structure has been presented here as an archetype, although we have touched on mixing forms and outlined various forms open license contracts currently take.

Based on previous research, we show that bazaar governance presents original characteristics in terms of its strengths and weaknesses and how it coordinates transactions. If we consider only incentives and control intensity, bazaar governance would seem far less attractive than other forms of organization. In this article, we underline the necessity of moving from the single transaction unit of analysis put forward in TCE to the cumulative effect of transactions to understand the efficiency of bazaar governance.

Theorizing the governance of open source projects as bazaar enables us to identify the general characteristics of these projects and is an attempt to generalize from previous literature that has focused particularly on two famous examples: Linux and Apache (this literature includes Wayner 2000; McKelvey 2001; Franke and von Hippel 2003; Hertel et al. 2003; Lakhani and von Hippel 2003; Lee and Cole 2003; O'Mahony 2003). Linux and Apache are not only projects that are particularly prominent and successful in terms of market penetration, they tend to focus attention solely on the software industry. So, despite being of crucial interest in apprehending this new phenomenon, these examples cannot be considered as representative of the thousands of existing open source projects.

The theoretical template we propose implies three consequences. First, as a generic governance structure, bazaar can be generalized to settings other than software. Second, because of its original characteristics, pure bazaar can be expected to experience a high rate of failure, despite the optimistic bias of the literature as a result of its focus on successes. Finally, our theorization enables to understand the evolution of this archetypical form towards mixing forms to counterbalance its intrinsic weaknesses. This last point is not, however, an exclusive attribute of bazaar, as in practice other structures also evolve towards mixed forms — to avoid, for instance, bureaucratization (in a hierarchy), overembeddedness (in a network) or blatant opportunism (in a market).

Following from these three theoretical deductions, this paper opens a vast potential for future research. Further contributions should embrace settings other than the software industry. It appears that the bazaar is particularly suitable for industries based on codified information goods, and Lecocq and Demil (2002) research into the tabletop roleplaying game industry is one study of bazaar governance within a non-software industry. Moreover, the potential applications of the open license contract are relevant to a vast array of transactions. Future research should look further into this issue. According to TCE, a fit must be established between governance structure and the characteristics of transactions, so it is important to examine what characteristics are typical of transactions that can be organized efficiently under bazaar governance. A subsequent question relates to the evaluation of production and transaction costs in bazaar governance.

Empirical investigations could also extend the scope of the open source projects studied to incorporate more diversity in their samples. For example, Krishnamurthy (2002) and Gosh and Prakash (2000) provide more contrasted results in their examinations of the economics of open source projects than case studies of successful projects imply. Another avenue of research would be to consider the conditions under which bazaar governance evolves toward mixing governance forms. In particular, it could be interesting to investigate the antecedents of the incorporation of new characteristics into an archetypical form. For instance, the Linux and Apache cases suggest that increasing complexity and the number of participants in a project favors the emergence of hierarchy mechanisms in bazaar governance.

We hope that this paper will encourage academics to inquire into open-source topics outside the traditional context of software, and will encourage managers to be cognizant with this new governance structure and thereby enrich their governance repertoire.

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