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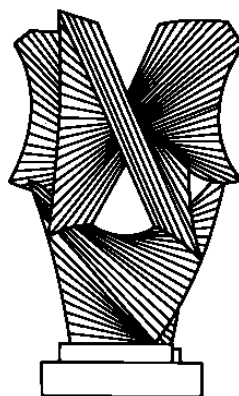
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## Regulation by Networks

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# Regulation by Networks

Amitai Aviram\*

The private ordering literature examines how nongovernment institutions mitigate opportunistic behavior in transactions. It emphasizes two elements that facilitate cooperation and reduce opportunism: repeated play and reputation. This paper explores the implications of a third element: network effects.

Network effects create an incentive for a unique form of opportunism that exists only in network environments—degradation. On the other hand, network effects facilitate mechanisms that may be very effective in mitigating opportunism. Therefore, in certain industries, networks mitigate opportunism, largely displacing in that role the parties to the transaction and the government.

This paper identifies mechanisms used by networks to reduce opportunism, and market characteristics that are conducive to the effectiveness of these mechanisms (and therefore to the efficiency of networks as regulators). This helps explain the prevalence of networks in certain markets as compared to others, and gives tools to assess networks' ability to self-regulate and anticipate the type of opportunism that is more likely to plague a given environment.

Public and private regimes of behavior regulation coexist, in varying degrees of harmony, in many aspects of life. Law, even under a narrow definition that excludes private regulatory regimes (known as Private Legal Systems), must address the degree of accommodation public regulatory regimes will afford their private counterparts. Some fields of law—most notably contract and property laws—enforce forms of private regulation that are perceived as beneficial. Other fields of law (in particular, antitrust) prohibit forms of private regulation that are perceived as harmful.

Many other fields of law do not directly address private regulation, but may be designed in ways that either facilitate or hinder coexistence of public and private law in a given area. For example, imposing liability on private institutions that unknowingly facilitate illegal activity

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assists in preventing the illegal activity, but imposes an additional cost on the private entities. This issue has received much attention recently in connection with the media industry's attempt to impose liability for copyright violations on peer-to-peer exchanges (notably, Napster),<sup>1</sup> as well as regulators' attempts to impose liability on online payment systems that facilitate payments involved in illegal gambling.<sup>2</sup> This liability may deter some efficient private schemes. The result may or may not be socially beneficial, depending on the social benefits from the private scheme and their relative advantage (or disadvantage) over public counterparts.

The legal scholarship known as 'private ordering' serves these bodies of law by assessing the social benefits and relative advantages of private regulation regimes. In analyzing private institutions, this literature emphasizes two elements that are used to mitigate harmful, opportunistic behavior: repeated play and reputation. This paper discusses a third element: network effects.<sup>3</sup> There is a significant literature on the economics of network effects, and some scholars have discussed the application of network effects into legal analysis.<sup>4</sup> Private ordering, however, has examined only passingly the implications of network effects, and rarely distinguishes between private institutions that are networks (such as exchanges, merchant coalitions, etc.) and those that are not. As a result, the private ordering literature does not

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<sup>1</sup> See *A&M Records, Inc. v. Napster, Inc.*, 239 F.3d 1004 (Ninth Cir. 2001) (record companies and movie publishers found to have made prima facie case of copyright infringement by Napster, a peer-to-peer system for online exchange of files); *Ellison v. Robertson*, 189 F.Supp. 2d 1051 (C.D. Cal. 2002) (posting of copyrighted material on an America Online USENET newsgroup found to come within the scope of the Digital Millennium Copyright Act's safe-harbor provision for "intermediate and transient storage").

<sup>2</sup> See, e.g., the New York Attorney General's investigation of PayPal, Inc. (an online payment system), for its involvement in processing payments related to online gambling activities. "PayPal Inc. to Stop Processing Payments From New Yorkers", *The Wall Street Journal*, August 22, 2002, page B8.

<sup>3</sup> As discussed *infra*, in section II.1, network effects (or network benefits) are demand-side economies of scale. That is, the phenomena that the utility to a user of a good or service increases as additional people use it. Often (though not always) realization of network effects requires interconnection between the users. The institution that facilitates interconnection between users of a good or service exhibiting network effects, and thus enables the realization of the network effects, is called a **network**.

<sup>4</sup> See, e.g., Richard A. Posner, *Antitrust Law* (Second Ed., 2001) 245-256 (analyzing exclusionary practices in the "new economy", which is characterized by significant network effects); David A. Balto, *Networks and Exclusivity:*

examine types of opportunistic behavior that are unique to network environments, and it emphasizes mechanisms that are common to both network and nonnetwork environments (e.g., reputation), sometimes neglecting other mechanisms that are very effective in network environments (e.g., coordinated exclusion from the network, and centralized control of transactions).

This paper will explore the implications of network effects on the ability (and relative advantage) of private institutions to mitigate opportunistic behavior. These implications are three-pronged. First, network effects allow a certain type of opportunistic behavior (which this paper, following recent economic literature, calls degradation), that is unprofitable to the opportunistic party in nonnetwork environments). Some anti-opportunism mechanisms that are commonly used against ‘garden variety’ opportunism are ineffective against degradation, making a regime whose strengths lie in these mechanisms less efficient as the regulator if degradation is likely to occur. Second, network effects make certain mechanisms far more effective in combating opportunistic behavior. The paper classifies four such mechanisms commonly used by networks, and assesses in which market structures they will be most effective. Third, the paper examines the ability of networks to modify themselves so as to become more efficient regulators, when the incumbent network has the ability to mitigate opportunism efficiently, but not the incentive to do so. Such modified networks have been observed and discussed in the antitrust scholarship (where they have been called “middleware”), but have yet to receive significant attention from the private ordering literature.

Part I of this paper examines the risk of opportunism in transactions, and the institutions that attempt to mitigate this risk. It analyzes the private ordering literature on the matter, and the

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Antitrust Analysis to Promote Network Competition, 7 *Geo. Mason L. Rev.* 523 (1999); Mark A. Lemley & David McGowan, *Legal Implications of Network Economic Effects*, 86 *Cal. L. Rev.* 479 (1998).

two elements that literature has emphasized: repeated play and reputation. Part II adds network effects into the analysis. It surveys the relevant economic literature and applies it to the private ordering framework. Four types of mechanisms used by networks to mitigate opportunism are classified and discussed, and degradation is explained and distinguished from opportunism that is not unique to networks (which the paper calls ‘breach’). The paper then examines the relationship between market structure and opportunism, and touches briefly on relevant effects of opportunism of either type on social welfare.

Part III explores the ‘competition’ between opportunism-mitigating regulatory regimes at the government level, at the network level (i.e., enforced by networks), and at the transaction level (i.e., enforced by the specific parties to any given transaction). Building on the analysis (made in part II) of types of opportunism and types of opportunism-mitigating mechanisms, it predicts the relative advantages of each regulatory regime in various market structures. Finally, Part IV summarizes and concludes.

## **I. Transacting and Opportunism**

Opportunistic default on obligations<sup>5</sup> is an inherent risk in any transaction between parties lacking complete control over each other’s actions.<sup>6</sup> Such behavior harms the parties to the transaction by reducing the return to any investments they had made in reliance on the defaulted obligations. Since the defaulting party is not harmed by the devaluation of the reliance

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<sup>5</sup> Opportunism may be defined as “an act in which someone destroys part of the cooperative surplus to secure a larger share of it”. Robert D. Cooter, *The Theory of Market Modernization of Law*, 16 Int’l Rev. L. & Econ. 141, 150 (1996). For other general definitions of opportunism, see: Michael P. Van Alstine, *The Costs of Legal Change*, 49 UCLA L. Rev. 789, 834 (2002) (defining opportunism as “bad faith exploitation of uncertainty”); Oliver E. Williamson, *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting* 47 (1985) (defining opportunism as “self interest seeking with guile”). In the context of contract law, opportunism has been defined as a situation in which one party “behaves contrary to the other party’s understanding of their contract, but not necessarily contrary to the agreement’s explicit terms, leading to a transfer of wealth from the other party”. Timothy J. Muris, *Opportunistic Behavior and the Law of Contracts*, 65 Minn. L. Rev. 521, 521-22 (1981).

investments of the other parties to the transaction, it might choose to default (absent some adverse sanction to such behavior) even when this results in a decrease in the combined welfare of all parties to the transaction. The devaluation of reliance investments is thus a negative externality imposed by opportunistic default on an obligation. Furthermore, recognizing the risk of default, parties to a transaction may decide to invest less in reliance on the transaction than they would have if opportunistic default had been less probable or less damaging; this lower investment might result in lower utility from the transaction.

Because welfare would be increased by lowering the probability of opportunistic default on obligations or by decreasing the damage caused by such default, potential parties to transactions seek forms of regulation that would achieve either or both reduced probability and reduced damage from opportunistic default.<sup>7</sup> Different entities have different advantages and disadvantages as such regulators, and overlapping regulation by different entities may complement, or conflict, with regulation by other entities.

Parties to the transaction have an unbiased incentive to prevent opportunistic default on obligations (to the extent that the opportunism is at their expense),<sup>8</sup> and they also possess intimate knowledge of the transaction's subject matter (e.g., the industry in which it operates).

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<sup>6</sup> This statement assumes that there is no anti-opportunism regulation of the transaction (e.g., enforceable contract law). If such regulation exists, the statement would still be true where the regulating regime has weaknesses (in the case of contract law – where the contract is incomplete).

<sup>7</sup> The term '**regulation**' has a variety of definitions, some so broad as to encompass any constraint that limits free choice, others so narrow as to relate only to government activity that mandates to firms in certain industries consumer prices. In this paper, the term 'regulation' regards activity (by any institution or individual) aimed at mitigating opportunistic behavior in transactions. Often, regulation is facilitated through intervention of an entity other than the parties to the transaction. However, one form of regulation (perhaps aptly termed 'self-regulation') involves mechanisms implemented by parties to the transaction with the intent to protect against undesirable behavior with regard to the transaction. For example, forming long-term relationships with certain parties and abstaining from contracting with others would be considered a form of regulation against opportunistic default. Regulation, therefore, spans a wide range of forms, from self-regulation by the parties to the transaction, through "gatekeepers" (see *infra*, text regarding note 11), to regulation by networks and finally to regulation by government.

<sup>8</sup> Some parties may enter a transaction with the intent to defraud, and therefore would not have at any stage an interest in preventing opportunism. However, if a mechanism was available that would prevent opportunism, the

However, their ability to punish opportunism is limited since, absent coordination with or assistance from others, they can only deprive the defaulting party of their future mutual transactions. If the value of such transactions is not great (for example, where the defaulting party will be able to transact with other, similarly attractive, firms), this sanction would fail to deter some opportunistic behavior.

Government is a natural candidate for regulating opportunism in transacting. Having a monopoly on violence and controlling specialized enforcement agencies that can enforce injunctions, fines and damages awards, the government can impose unique sanctions such as incarceration,<sup>9</sup> and has better ability to impose fines than do most other potential regulators. Unsurprisingly, therefore, law and government enforcement of it have a significant role in regulating (such great a role, in fact, that many view it as the sole, or at least the primary method of regulation). Contract law is intended to lend the power of government's enforcement machinery to parties injured by breach of obligations. Commercial law provides more specific rules for certain common types of commercial transactions, intended (among other reasons) to curb opportunistic frustration of the goals of those transactions. Consumer protection law is, to a significant degree, aimed at correcting information asymmetries that make opportunistic behavior more likely. Antitrust law similarly addresses opportunism that is caused by the possession or attempted acquisition of market power.<sup>10</sup> Industry-specific regulation often monitors for (and remedies) opportunism by or against the firms it regulates.

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refusal of a party to implement it would signal to other parties a likely intent to defraud. Therefore, at least ex ante, parties to a transaction are likely to agree to implement mechanisms mitigating opportunism.

<sup>9</sup> Government would rarely impose incarceration on even the most guileful opportunism. *See infra* note 92.

<sup>10</sup> *See, e.g., Digital Equipment Corp. v. Uniq Digital Technologies, Inc.*, 73 F.3d 756, 762 (7<sup>th</sup> Cir. 1996), distinguishing *Eastman Kodak Co. v. Image Technical Services, Inc.*, 504 U.S. 451, 112 S.Ct. 2072, 119 L.Ed.2d 265 (1992).



Third parties other than government are also enlisted as regulators, if they have relevant advantages over the parties to the transaction and the government. For example, investment banks, accountants, law firms and other financial intermediaries often serve as “gatekeepers”, since they have advantageous access to information regarding potential opportunism.<sup>11</sup> Other third parties, such as exchanges and trade associations, create rules, adjudication and enforcement mechanisms that are intended to reduce opportunism.<sup>12</sup>

Some third parties not only enjoy potential informational advantages, but also possess sanctions against offenders, that may rival or surpass the government’s in effectiveness (thus deterring opportunism and hence decreasing its likelihood) and are able to replace defaulted transactions with substitute transactions more efficiently than the parties to the transaction themselves (thus mitigating the damage from default). These third parties are networks - institutions that facilitate interconnection between users of a good or service exhibiting network effects, and thus enable the realization of the network effects.<sup>13</sup> Networks appear in many forms: trade associations, commodity exchanges, electricity grids, Internet auction sites, Peer-to-Peer and Business-to-Business exchanges, etc.<sup>14</sup> In certain circumstances, networks are better regulators than the parties to the transaction or other third parties (such as the government); in such cases, anti-opportunism mechanisms instituted by the network displace counterpart

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<sup>11</sup> See Reinier H. Kraakman, *Gatekeepers: The Anatomy of a Third- Party Enforcement Strategy*, 2 J.L. Econ. & Org. 53 (1986); Stephen J. Choi, Market Lessons for Gatekeepers, 92 Nw. U. L. Rev. 916 (1998); Ronald J. Mann, *Verification Institutions in Financing Transactions*, 87 Geo. L. J. 2225 (1999).

<sup>12</sup> See, e.g., Lisa Bernstein, *Opting Out of the Legal System: Extralegal Contractual Relations in the Diamond Industry*, 21 J. Legal Stud. 115 (1992); Lisa Bernstein, Private Commercial Law, in 3 *The New Palgrave Dictionary of Economics and the Law* 108 (Peter Newman, ed. 1998).

<sup>13</sup> This definition was made *supra*, note 3. For a discussion of network effects see *infra*, section II.1.

<sup>14</sup> Examples of business environments significantly influenced by networks include: exchanges (e.g., securities exchanges, commodity exchanges, etc.); financial networks (credit card networks, ATM networks, check clearance, etc.); communications (long distance and international telephony, cellular telephony, internet backbone services, etc.); transportation (air, sea, and land transportation); mail and express services (domestic and international); and energy networks (electricity, gas and oil pipelines).

measures applied through government regulation and bilateral contracting. Identifying these circumstances and the mechanisms used to combat opportunism is a goal of this paper.

The literature on private ordering examines regulation by parties other than government: rules, norms and institutions that are self-imposed by private parties (or evolve)<sup>15</sup> to govern their behavior and transactions.<sup>16</sup> Macaulay's seminal work in this field observed that few contractual disputes are litigated, and most are settled without resorting to government-enforced laws.<sup>17</sup> Subsequent research pointed out to advantages in mitigating opportunism that certain nongovernment institutions may possess. In analyzing the institutions that mitigate opportunism, this literature emphasizes two elements: repeated play and reputation.

The repeated-play element addresses the perception of the parties to a transaction that they are likely to transact again in the future. As a result of this perception, each party's behavior in the current transaction may have consequences in future transactions.<sup>18</sup> For example, if John promises to buy Dan's car, but then reneges on that promise, Dan may refuse to transact with John in the future, or may deal with John in the future under terms less favorable to John (both as punishment and because Dan now takes into account the greater likelihood of John defaulting again). Knowing these are the likely consequences, John will be hesitant to renege on his

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<sup>15</sup> Some norms are not contemplated and imposed, but evolve. See Eric A. Posner, *Law, Economics, and Inefficient Norms*, 144 U. Pa. L. Rev. 1697, 1699 (1996) ("The rule-like nature of a norm should not disguise the fact that norms are not enacted or enforced like statutes. It is more plausible to say that when people observe some behavior, they more or less spontaneously approve or disapprove of it (or fail to react), and then reward, penalize, or ignore the actor.").

<sup>16</sup> See, e.g., Stuart Banner, *The Origin of the New York Stock Exchange, 1791-1860*, 27 J. Legal Stud. 113 (1998); Lisa Bernstein, *Private Commercial Law in the Cotton Industry: Creating Cooperation Through Rules, Norms, and Institutions*, 99 Mich. L. Rev. 1724 (2001); Robert C. Ellickson, *A Hypothesis of Wealth-Maximizing Norms: Evidence from the Whaling Industry*, 5 J.L. Econ. & Org. 83 (1989); Curtis J. Milhaupt & Mark D. West, *The Dark Side of Private Ordering: An Institutional and Empirical Analysis of Organized Crime*, 67 U. Chi. L. Rev. 41 (2000).

<sup>17</sup> Stuart Macaulay, *NonContractual Relations in Business: A Preliminary Study*, 28 Am. Soc. Rev. 55 (1963).

<sup>18</sup> See David M. Kreps, *Corporate Culture and Economic Theory*, in *Perspectives on Positive Political Economy* (James Alt & Kenneth Shepsle, eds., 1990).

promise in the first place, at least if he anticipates the loss of future transactions with Dan to be greater than the benefit from renegeing on the current promise.

Reputation expands the scope of future consequences, by enabling other firms, which were not parties to a given transaction, to learn of the trustworthiness of the parties in that transaction and act on that knowledge.<sup>19</sup> Returning to the above example, John might realize that renegeing on his promise to Dan will not only make Dan's future reactions to him less favorable, but he might expect a similar reaction from anyone who learns of John's default. This reaction has nothing to do with sympathy for Dan—it is in the best interest of each person to be more averse to dealing with another person who is more likely to default on promises. A credible account of past behavior (*i.e.*, reputation) is usually perceived as a good proxy for assessing the likelihood of future default on obligations, and therefore interests third parties and affects their disposition towards the person whose reputation they are aware of.

This paper discusses a third element that affects the analysis of opportunism-mitigating institutions—network effects. Private ordering scholarship has examined business environments that are dominated by networks, such as merchant coalitions,<sup>20</sup> or commodity and financial exchanges.<sup>21</sup> It also notes the use of social networks to combat opportunism in business transactions.<sup>22</sup> However, it rarely distinguishes between institutions that are networks (that is,

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<sup>19</sup> See, e.g., Paul Milgrom, Douglass North & Barry Weingast, *The Role of Institutions in the Revival of Trade: The Law Merchant, Private Judges, and the Champagne Fairs*, 2 *Econ. & Pol.* 1 (1990).

<sup>20</sup> See Karen Clay, *Trade Without Law: Private-Order Institutions in Mexican California*, 13 *J.L. Econ. & Org.* 202 (1997); Avner Greif, *Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition*, 83 *Am. Econ. Rev.* 525 (1993); Milgrom, North & Weingast, *supra* note 19.

<sup>21</sup> See, e.g., Banner, *supra* note 16; Bernstein (2001), *supra* note 16; Stephen C. Pirrong, *The Efficient Scope of Private Transactions-Cost-Reducing Institutions: The Successes and Failures of Commodities Exchanges*, 24 *J. Legal Stud.* 229 (1995); Mark D. West, *Private Ordering at the World's First Futures Exchange*, 98 *Mich. L. Rev.* 2574 (2000).

<sup>22</sup> See, e.g., Janet T. Landa, *A Theory of The Ethnically Homogenous Middleman Group: An Institutional Alternative to Contract Law*, 10 *J. Leg. Stud.* 349 (1981). Also see Bernstein (1998), *supra* note 12, at p. 110; Bernstein (1992), *supra* note 12, at p. 130; Raja Kali, *Endogenous Business Networks*, 15 *J. of L. Econ. & Org.* 615 (1999).

that are characterized by network effects) and those that are not.<sup>23</sup> As a result, the literature usually discusses only types of opportunism that are common to both network and nonnetwork business environments,<sup>24</sup> and examines primarily regulation mechanisms that are common to both of these environments.<sup>25</sup>

Below I examine how transacting in a network environment involves both unique risks of opportunism and unique (or at least, in many circumstances, significantly superior) abilities to regulate against opportunism. I begin by examining the relevant characteristics of networks.

## II. Transacting in a Network Environment

### 1. Network Effects

While networks may enjoy economies of scale and scope *in production*, the unique quality of a network is economies of scale and scope *in demand*, referred to by economists as ‘network effects’: the value of membership in a network is enhanced by an increase in the number of other members or in the other members’ usage of the network. An example is an internet marketplace (such as eBay). If I want to sell an item, the probability that I find a potential buyer increases as more people use the same internet marketplace. And as a buyer, the

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<sup>23</sup> Some of the literature does make relevant distinctions. For example, McMillan and Woodruff distinguish between “bilateral relational contracting” and “multilateral relational contracting”. See John McMillan & Christopher Woodruff, *Private Order Under Dysfunctional Public Order*, 98 Mich. L. Rev. 2421, 2430-2435 (2000). Not all multilateral contracts are necessarily associated with networks. However, most of the multilateral contracts examined in the literature relate to networks, probably due to the advantages that a network possesses (over other multilateral institutions) in regulating.

<sup>24</sup> Typically, the private ordering literature examines opportunism of the type this paper defines, *infra* in section II.3, as ‘breach’. Transacting in network environments may also risk a markedly different type of opportunism, which this paper defines (again, *infra*, in section II.3) as ‘degradation’.

<sup>25</sup> For example, as mentioned above, the literature emphasizes the role of reputation in restraining opportunism. Networks may be able to exploit economies of scale and solve collective action problems in monitoring reputation (see discussion on the information mechanism, *infra*, section II.2), but they also have other opportunism-reducing mechanisms in their arsenal, including the ability to coordinate among the network members so that the opportunistic party faces a collective sanction from all members. Some scholars have addressed the need for coordination. See, e.g., McMillan & Woodruff, *supra* note 23, at p. 2438 (“Providing information about those who

probability that I find a person wishing to sell the very item I seek increases as more people use the marketplace.

In industries characterized by economies of scale in supply, firms lower their production costs by drawing more demand for their product, allowing them to produce more of the product and thus benefit from the economies of scale. But in network industries, firms can lower their costs<sup>26</sup> without having to wrest customers from their competitors - by interconnecting with competitors (*i.e.*, making one's product or service compatible with the competitors'), thus allowing its customers to reap demand-side economies of scale as if its competitors' customers were its own. As Richard Posner notes, "[E]conomies of consumption presuppose uniformity rather than a common source."<sup>27</sup>

For example, the benefit to customers of a cellular telephone company increase as they are able to talk to more people through their phones. A cellular telephone carrier could, by interconnecting with another carrier, offer its customers the added benefits of talking with the other carrier's customers, making each carrier's service as attractive as if one of the carriers acquired all of the other's customers. This characteristic of network industries creates a significant incentive for creating inter-firm networks.<sup>28</sup> It also makes membership in a large network (*i.e.*, the ability to transact through the network) a valuable asset,<sup>29</sup> and therefore the network's ability to exclude a member may be a powerful sanction.<sup>30</sup>

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cheat may not suffice to deter cheating when punishment is costly – coordination may be required..."). However, they have not focused on the connection between network effects and the effectiveness of coordinating mechanisms.

<sup>26</sup> Or increase the consumer's benefit from its products without increasing costs, which is equivalent to lowering costs.

<sup>27</sup> Posner, *supra* note 4, at p. 248.

<sup>28</sup> For example, banks created clearinghouses to facilitate the exchange and redemption of bank notes (and later checks). *See*: Alan S. Frankel, *Monopoly and Competition in the Supply and Exchange of Money*, 66 *Antitrust L. J.* 313. Later, banks created networks facilitating ATM and credit card transactions. *Id.*

<sup>29</sup> This does not mean that network effects inevitably result in natural monopolies. Differences in the quality of competing network goods, or in their production costs may offset the relative advantage of the larger network. Furthermore, production costs often exhibit at a certain point decreasing returns to scale (*i.e.*, they rise as production

The concept of network effects is not at all a novel one. Perhaps the most ancient example of recognition of the enhanced benefits that result from connectivity between entities is found in the book of Genesis: "Here they are, one people with a single language, and now they have started to do this [building the Tower of Babel]; henceforward nothing they have a mind to do will be beyond their reach..."<sup>31</sup> Language is characterized by network effects—the benefit derived from communicating in a language increases significantly as more people are familiar with it.<sup>32</sup> Increased “membership” in this network (*i.e.*, fluency in the language) allows communication and coordination among a larger number of people (which confers greater benefits to each of them). Babel was destroyed by undoing its linguistic network: "...Come, let us go down there and confuse their speech, so they will not understand what they say to one another.' So the Lord dispersed them from there all over the earth, and they left off building the city. That is why it is called Babel, because the Lord there made a babble of the language of all the world."<sup>33</sup>

Significantly later, economists made similar, and more refined, observations of industries in which the utility to a consumer (a member of the network) increased with the number of other consumers using the same product. For example, Rohlfs noted network effects in communications services industries, and examined the influence of network effects on pricing

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increases). This increase in cost may offset the increasing returns to scale derived from the network effect. See S. J. Liebowitz & Stephen E. Margolis, Network Effects and Externalities, in 2 The New Palgrave Dictionary of Economics and the Law 671, 672 (Peter Newman, ed. 1998).

<sup>30</sup> See, e.g., Bernstein (2001), *supra* note 16, at pp. 1767-8 (“Although most transactors are willing to deal with nonmembers (albeit somewhat reluctantly and on slightly different terms) as long as they have good reputations, they are extremely reluctant to deal with someone who has been expelled from an association. As one mill explained, for a merchant, “be[ing] expelled [from a shippers’ association] is usually a death blow to [his] business.””) (footnotes omitted, bracketed text in original).

<sup>31</sup> Genesis, 11:6.

<sup>32</sup> . For a more contemporary analysis of network effects of language, see, e.g., Jeffrey Church & Ian King, *Bilingualism and Network Externalities*, 26 Canadian J. Econ. 337 (1993).

<sup>33</sup> Genesis, 11:7-8.

and barriers to entry into the industry.<sup>34</sup> Such effects are considered direct network effects, as they are generated through a direct physical effect of the number of consumers on the value of a product.<sup>35</sup> Other scholarship identified indirect network effects—an increase in the value of a product as a result of an increase in the purchase or use of a complementary product. For example, if more people use Excel, there will be more people any given user can obtain help from and more books and courses on how to use Excel; if more people carry MasterCards, more merchants will take MasterCards, making the cards more valuable to both cardholders and merchants.<sup>36</sup>

As such observations identified an increasing number of industries in which network effects significantly influence the behavior of firms, scholars developed models simulating network environments. A key work examining competition in network environments was offered by Katz and Shapiro.<sup>37</sup> Their model demonstrated that the presence of network effects and the need for compatibility lead to multiple equilibria, and consumers' expectations are key in determining which equilibrium emerges. Generally, consumers will prefer to join a network that they perceive as likely to become (or is already) the market leader. This preference may set off consumers' preferences regarding the product or service itself, so that (it was argued) an inferior product that is perceived to be the market leader (perhaps because it was a first-mover into the market) will be preferred over superior but smaller competitors.

This argument led to a line of literature examining network effects as barriers to entry, and as the cause of the alleged persistence of less efficient network goods. Another paper by

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<sup>34</sup> Jeffrey Rohlfs, *A Theory of Interdependent Demand for a Communications Service*, 5 Bell J. Econ. & Man. Sci. 16 (1974).

<sup>35</sup> See Liebowitz & Margolis, *supra* note 29, at p. 671.

<sup>36</sup> David S. Evans & Richard Schmalensee, *A Guide to the Antitrust Economics of Networks*, 10 Antitrust 36 (1996).

<sup>37</sup> Michael L. Katz & Carl Shapiro, *Network Externalities, Competition and Compatibility*, 75 Am. Econ. Rev. 424 (1985).

Katz and Shapiro showed that the presence of network effects may lead to excessive standardization.<sup>38</sup> Farrell and Saloner created a model suggesting that new technology may not be adopted even if it is superior to existing technology, because of ‘excess inertia’ caused by the presence of an installed base.<sup>39</sup> David offered the anecdotal example of the persistence of the “QWERTY” keyboard to argue that industries may lock-in to inefficient standards.<sup>40</sup> Other scholars rejected the likelihood of an inefficient lock-in. Liebowitz and Margolis refuted the lock-in hypothesis in the QWERTY anecdote,<sup>41</sup> as well as in another much cited anecdote, that regarding the VHS/Beta competition over the video cassette standard.<sup>42</sup> This issue is still disputed among scholars.<sup>43</sup>

Another issue emphasized by Katz and Shapiro is decisions regarding compatibility. Compatibility may be achieved by joint decision (e.g., coordinated acceptance of a standard), or unilaterally, by the construction of an ‘adapter’ by a single firm, to make its product compatible with another.<sup>44</sup> Private incentives for compatibility may differ from public incentives, possibly resulting in private action that fails to maximize social welfare from the network effects. One strand of the literature examined the choice between unilateral and coordinated facilitation of compatibility.<sup>45</sup> This issue is of considerable importance to antitrust scholarship, as coordinated

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<sup>38</sup> Michael L. Katz & Carl Shapiro, *Technology Adoption in the Presence of Network Externalities*, 94 J. Pol. Econ. 822 (1986).

<sup>39</sup> Joseph Farrell & Garth Saloner, *Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation*, 76 Am. Econ. Rev. 940 (1986).

<sup>40</sup> Paul A. David, *Clio and the Economics of QWERTY*, 75 Am. Econ. Rev. 332 (1985).

<sup>41</sup> S. J. Liebowitz & Stephen E. Margolis, *The Fable of the Keys*, 33 J. L. & Econ. 1 (1990).

<sup>42</sup> S. J. Liebowitz & Stephen E. Margolis, *Path Dependency, Lock-in and History*, 11 L. Econ. & Org. 205 (1995). On these two anecdotes and a few others *also see*: S. J. Liebowitz & Stephen E. Margolis, *Should Technology Choice be a Concern to Antitrust Policy?*, 9 Harv. J. L. & Tech. 283 (1996); Michael I. Krauss, *Regulation v. Markets in the Development of Standards*, 3 S. Cal. Inter. L. J. 781 (1994).

<sup>43</sup> *See, e.g.*, William E. Cohen, *Competition and Foreclosure in the Context of Installed Base and Compatibility Effects*, 64 Antitrust L.J. 535, 539-546 (1996).

<sup>44</sup> Katz & Shapiro (1985), *supra* note 37, at pp. 434-439.

<sup>45</sup> *See, e.g.*, Joseph Farrell & Garth Saloner, *Coordination Through Committees and Markets*, 19 Rand J. Econ. 235 (1988) (comparing committee agreement on standards; unilateral declarations of standards by single firms, followed by independent decisions by other firms which standard to follow; and a hybrid system adapting features of both the



facilitation of compatibility is usually more suspect of being used for anti-competitive ends than its unilateral counterpart, and it is therefore important to understand whether it has a redeeming advantage in increasing social welfare through exploitation of network effects.<sup>46</sup>

Another strand of the compatibility literature examines the incentives for a decision not to be compatible with others, and the effect of such decisions on social welfare. Compatibility is not always efficient. Network effects (i.e., demand-side increasing return to scale) are usually reduced and might even reverse above a certain point (e.g., due to congestion on the network, or relative advantages of one system over another, that have to be sacrificed to ensure compatibility).<sup>47</sup> Therefore, there may be a maximum efficient size for a network, and a refusal to allow compatibility with other systems may be designed to prevent a network from expanding beyond its efficient size. Furthermore, facilitating compatibility has various costs (e.g., actual

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committee and the market leadership mechanisms); Joseph Farrell & Garth Saloner, *Converters, Compatibility, and the Control of Interfaces*, 40 J. Ind. Econ. 9 (1992) (finding that when adapters do not facilitate perfect compatibility, their introduction might reduce social welfare below that in an industry without adapters at all).

<sup>46</sup> See: United States Department of Justice and Federal Trade Commission, *Antitrust Guidelines for Collaborations Among Competitors*; *Eliason Corp. v. National Sanitation Foundation*, 614 F.2d 126 (6<sup>th</sup> Cir. 1980) (stating that alleged boycotts arising from industry self-regulation do not give rise to a Sherman Act violation absent discrimination or manifestly anticompetitive and unreasonable conduct). But compare: *Fashion Originators' Guild of America v. FTC*, 312 U.S. 457 (1941) (condemning coordinated activity aimed at preventing and punishing "style piracy" and stating that "even if copying were an acknowledged tort under the law of every state, that situation would not justify petitioners in combining together to regulate and restrain interstate commerce...").

<sup>47</sup> Congestion is a major limit on efficient scales in rivalrous networks (networks in which, besides the positive network externality, there is a negative externality imposed by an additional member of the network on the other members. Rivalrous networks include, inter alia, cellular phones, broadband Internet and peer-to-peer information networks. Nonrivalrous networks, such as languages, PC or video cassette standards, etc., do not suffer from congestion (e.g., it is no more difficult for me to express myself in English merely because many millions of additional people also express themselves in English). However, other traits might impose a limit on the efficient size of the network. For example, certain languages may express some matters in greater precision than others, and compatibility, meaning integrating one language into another or creating a one-to-one translation for each word, will result in losing those nuances. Eskimos are said to have hundreds of words describing types of ice; to allow complete compatibility with other languages, all these nuanced differences must be sacrificed and the various words translated into the general word "ice". The same is true for standards. For example, the JPEG computer graphic file standard is better than the competing GIF standard for multi-color images, but poorer when the image contains large areas with the same color. See: "GIF vs. JPEG", available at: <http://hotwired.lycos.com/webmonkey/geektalk/97/30/index3a.html?tw=design>. The choice between standards or languages will depend on which nuances or special advantages are more commonly used by each prospective member of the network. Those with a strong preference to a nuance or specific advantage will prefer to maintain this advantage even at the price of foregoing additional network benefits (e.g., people who care for minute differentiation when referring to types of ice might prefer to speak a more obscure, but also more exacting language).

costs of coordination, loss of freedom to vary due to the need to remain compatible, forced disclosure of proprietary information, and facilitating anti-competitive coordination). For this reason, a refusal to be compatible may at times increase social welfare.

However, firms may have incentives to refuse to be compatible even when compatibility would increase social welfare. Farrell and Saloner observed that in decisions whether to make two technologies compatible, when one technology is supplied by a single firm, that firm may have an incentive to make conversion costly.<sup>48</sup> Cremer, Rey and Tirole expanded on this insight, terming this increase in the cost of compatibility (or a reduction in its quality) “degradation”.<sup>49</sup> They refer to compatibility as “connectivity” and examine the plausibility of such a strategy and its effect on social welfare. This paper examines (among other issues) “degradation” as a form of opportunistic behavior.

While the social welfare implications of network effects have been and continue to be examined thoroughly, less attention has been given to the implications of network effects on the form of organization. Even less attention has been given, within this latter issue, to the implications of network effects on institutions that mitigate opportunism (i.e., how network effects are used to fight “garden variety” opportunism, and how institutions combat opportunism that is unique to network environments).

Much of the research following Macauley’s observation on opting out of the governmental legal system examined bilateral, relationship-based transacting, in which reputational investments in the relationship serve as collateral against opportunism: Geertz noted

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<sup>48</sup> Farrell & Saloner (1992), *supra* note 45, at pp. 26-28.

<sup>49</sup> Jacques Cremer, Patrick Rey & Jean Tirole, *Connectivity in The Commercial Internet*, 48 J. Indus. Econ. 433 (2000).

that buyers and sellers in bazaars tend to pair off in recurrent transactions.<sup>50</sup> Posner pointed to a similar pattern of “barter friendships” within primitive societies, which oblige the parties to similar standards of loyalty as they owe their kinsmen.<sup>51</sup> Such a status and its attached obligations serve to mitigate opportunism despite the absence of public enforcement.<sup>52</sup> Landa expanded Geertz’s and Posner’s observations by considering a wider, network relationship, which she identified as an “ethnically homogenous middleman group”.<sup>53</sup> This group facilitates exchanges where government enforcement of law is deficient (and therefore the certainty of abiding to contracts is lacking), by taking advantage of the high barriers to entry into an ethnic social group (and therefore the need to stay on good terms with one’s existing ethnic group).<sup>54</sup> Landa follows the method of analysis used earlier by Akerlof to explain the caste system in India:<sup>55</sup> an ethnic group can impose an efficient code of behavior through the threat of exclusion, and it can provide low-cost, accurate information on the trustworthiness of its members by economizing on information-collection. Landa’s focus, therefore, is on networks’ mitigation of informational asymmetries.

A few scholars examined the effects networks have in coordinating punishment against opportunists. Greif modeled a “Multilateral Punishment Strategy” patterned after the Maghribi

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<sup>50</sup> Clifford Geertz, *The Bazaar Economy: Information and Search in Peasant Marketing*, 68 *Am. Econ. Rev.* 28 (1978). For similar observations also see: Cyril Belshaw, *Traditional Exchanges and Modern Markets* (1965) (Noting that traders in traditional markets tend to personalize their exchange relations to mitigate contractual uncertainty (i.e., opportunism)).

<sup>51</sup> Richard A. Posner, *A Theory of Primitive Society, with Special Reference to Law*, 23 *J. Law & Econ.* 1 (1980).

<sup>52</sup> *Id.*, at p. 26.

<sup>53</sup> Landa, *supra* note 22.

<sup>54</sup> It is worthwhile to note that the barriers to entry into an ethnic social group are generally not directly related to network effects. The difficulty of joining such a group does not tend to have a relationship to the size of the group, but rather to its customs of recognizing kinship. Ethnic groups rarely accept as kin people who are unrelated by blood or marriage (though, as Posner notes in his paper, *supra* note 51, this occasionally occurs). Since it is difficult to join a new ethnic group, severing ties with one’s original ethnic group is harmful, especially in a society in which most people do not deal with others who are not of their ethnic group.

<sup>55</sup> See: George Akerlof, *The Economics of Caste and of the Rat Race and Other Woeful Tales*, 90 *Q. J. Econ.* 599, 608-611 (1977).

merchant coalitions.<sup>56</sup> His model considered what is effectively a decentralized network, in which the decisions (mainly, whether to punish or exclude opportunists) are made by each member separately, and the network facilitates the exchange of information that identifies a member as an opportunist (therefore, it is an extension of the reputation element). Clay modified this model, patterned after merchant coalitions in early 19th Century Mexican California, to incorporate different strategies of specific merchants regarding dealing with people whom other members of the network tagged as ‘dishonest’.<sup>57</sup> McMillan and Woodruff point to the role of private-order organizations in coordinating responses to opportunism (in addition to collecting information to detect such opportunism).<sup>58</sup>

This paper classifies the mechanisms that networks use to mitigate opportunism, from a perspective of manipulation of network effects. Besides classifying the observations of the abovementioned literature in two categories (“information mechanisms” and “exclusion mechanisms”, such a perspective sheds light on two other types of mechanisms that are used by networks for the same purpose (“control mechanisms” and “switching mechanisms”).

## *2. Mechanisms for Regulation in Networks*

Network effects are the source of several comparative advantages that networks possess in regulating, compared to regulation by other institutions. First, the network is often able to mitigate the damage caused by opportunistically defaulted transactions, by quickly and inexpensively finding an alternative to the defaulting party (in the terms and context of the Uniform Commercial Code, this would be considered “covering” for a breached transaction). The ability to find an alternative transaction not only mitigates the damage from the opportunistic default (by transferring some of the reliance investment in the defaulted transaction

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<sup>56</sup> Greif, *supra* note 20.

<sup>57</sup> Clay, *supra* note 20.

to another transaction), but also deters some types of opportunism that are based on re-negotiating an agreement with captive customers. This paper will refer to this form of opportunism-reduction as the *Switching Mechanism*.

For example, John and Jane are dealers in premium widgets. Premium widgets are very expensive luxury items, and rare (and foolish) is the dealer that deals with a partner that lacks an established reputation. Furthermore, the size of the deal (and therefore the amount of risk a default on it would pose to the injured party) depends on the degree to which the other party's reputation has been established, so deals with new partners are initially small, and grow as the partner's reputation is established.<sup>59</sup> If no network (i.e., exchange) exists, John and Jane would be sensible to concentrate their transactions with each other, building their respective reputations and giving them the assurance required to risk bigger (and more profitable) transactions. In fact, that's precisely what they did, and John has dealt to date exclusively with Jane. Now, having reached sizable (and therefore both very risky and very profitable) transactions, Jane reneges on an agreement and offers to renegotiate it in a manner much more favorable to her (she may find it profitable to do so if she, unlike John, has alternative trading partners, or if the stakes in this deal are so great as to dwarf her future expected gain from dealing with John). John can either acquiesce to the renegotiated deal, or lick his wounds and begin trading with someone else, expending time and foregone profits as he builds his reputation anew.

John could fair better if premium widgets were traded on the Premium Widget Exchange, which like many exchanges has an efficient switching mechanism: reputation is exchange-wide, perhaps because the exchange collects and reliably assesses each member's past behavior, and each exchange member consults with their potential partner's reputation record, which the

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<sup>58</sup> McMillan & Woodruff, *supra* note 23.

exchange provides, in order to decide whether the potential partner is trustworthy enough for the size of the deal contemplated.<sup>60</sup> Upon Jane's reneging on the agreement, John could, if he were a member of the exchange, easily trade with another exchange member, foiling Jane's attempt to renegotiate. Other exchange members would regard John's reputation as established, based on his previous dealings with Jane, which were recorded and positively assessed by the exchange.

The exchange's system of network-wide reputation lowers the barriers to exchange with someone other than the opportunistic party. Techniques allowing this, which this paper terms switching mechanisms, are not unique to networks. A switching mechanism has been found to deter opportunism and increase reliance in bilateral relationships in nonnetwork environments.<sup>61</sup> Absent elaborate and accessible reputation-assessing and distributing systems, network transactions may sometimes be more anonymous than bilateral transactions. But when it is feasible for networks to construct such systems, they have two advantages over other institutions in using the switching mechanism. First, in network environments many investments tend to be network-specific rather than transaction-specific, and therefore they are salvageable through the switching mechanism.<sup>62</sup> Second, networks usually facilitate a transacting environment that more closely resembles the hypothetical perfectly competitive market than do discrete bilateral arrangements. Therefore, the switching mechanism tends to be more effective in network environments than in nonnetwork counterparts.

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<sup>59</sup> This dynamic is hardly unique to the hypothetical example. Rather, it has been commonly observed by scholars. See, e.g., Geertz, *supra* note 50; Belshaw, *supra* note 50; Posner, *supra* note 51.

<sup>60</sup> An example of a similar exchange-wide reputation database is eBay's feedback forum. See: <http://pages.ebay.com/services/forum/feedback.html>.

<sup>61</sup> See: Thomas M. Palay, *Comparative Institutional Economics: The Governance of Rail Freight Contracting*, 13 J. of L. & Econ. 265, 271-273 (1984).

<sup>62</sup> For example, a large portion of one's reputation may be network-specific if dealing in a network, and transaction-specific if dealing bilaterally. To illustrate, one might think of an industry in which, due to the risk exposure involved, one transacts only with partners who have established good reputations. If I trade bilaterally and my partner defaults on me, I will need to establish a good reputation with another potential partner (a costly and time-consuming process) before I can cover for the defaulted transaction. Were the transactions processed through a

Network effects also enable networks to use a second mechanism to enforce regulation, which the paper will call the *Exclusion Mechanism*. Since network effects, when significant, grant significant utility and decrease markedly the cost of transacting, a member in the network may be greatly harmed by ceasing to have access to it. Therefore, the network wields a significant sanction over its members, in the form of exclusion (or suspension)<sup>63</sup> from the network. As mentioned above,<sup>64</sup> coordination of anti-opportunism measures enhances the effectiveness of these measures. A network is in excellent position to coordinate members' sanctions, and through exclusion denies from the offending party the network benefits conferred by the other members). In some industries, most business is conducted through the network, and therefore exclusion from the network precludes a firm from most potential transactions. In many industries, exclusion from certain networks results in nonmembers' refusal to deal with the excluded firm.<sup>65</sup> Hence, exclusion from a network may result in exclusion from the entire line of business; this is a very powerful sanction, rivaling the government's in effectiveness.<sup>66</sup>

Besides denying the opportunistic member of the network's benefits, exclusion also reduces the value of (or eliminates) the network-specific investments that the member has made.

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network, my reputation would have, most likely, been network-wide, so any other member of the network would already know of my reputation and be willing to deal with me, with no cost of re-establishing my trustworthiness.

<sup>63</sup> The use of a penalty of suspension, rather than exclusion, is sometimes preferred in order to avoid an 'endgame' situation in which the expelled party has nothing to lose once it acted opportunistically in a certain instance. See Bernstein (1992), *supra* note 12, at p. 129.

<sup>64</sup> Citing McMillan & Woodruff, *supra* note 23.

<sup>65</sup> Nonmembers' refusals to deal may be independent, due to viewing the expulsion as a signal regarding the trustworthiness of the expelled member. Alternatively, nonmembers might have undertaken an obligation to refuse to deal with persons expelled or otherwise sanctioned by the network. Such obligations de facto expand the size of the network that is being regulated. An example of such an obligation is a bylaw of the World Federation of Diamond Bourses, requiring all members to enforce arbitration judgments of other members. See Bernstein (1992), *supra* note 12, at p. 121.

<sup>66</sup> See Bernstein (1998), *supra* note 12, at p. 109 ("In most industries, however, it is rarely necessary for a party to seek judicial enforcement of an [arbitration – A.A.] award. Merchant tribunals are able to place their own pressures on the parties to comply promptly with their decisions. In the diamond industry, for example, when a party does not comply with an arbitration award, every diamond bourse in the world posts his picture along with a statement detailing his noncompliance. He may also be suspended or expelled from the bourse that rendered the judgment and banned from entering all bourses in the World Federation of Diamond Bourses. Being subject to these types of sanctions makes it unlikely that a trader will be able to remain in the diamond business.").

The nature and value of these investments varies from network to network. Investments may include physical elements required to connect with the network (which may be unsalvageable, and useless if connection to the network is denied), network-wide reputation, etc. Viewed from this perspective, the assets over which a member surrenders control to the network are a form of bond,<sup>67</sup> or a “hostage”.<sup>68</sup> An example is the charge of admission fees by trade associations, and their control over information provided by them to their members. Trade associations may confiscate these fees and other assets over which the network has control, as sanctions against a member’s opportunistic behavior.<sup>69</sup>

A network’s ability to prevent opportunism is also enhanced by a characteristic that is common to most (but not all) networks—centralized control<sup>70</sup> over the facilities used for transacting (“*Control Mechanism*”).<sup>71</sup> In social networks, these facilities might be reputation or accrued goodwill. In transportation networks these might be terminals and jointly used tracks or roads; in exchanges, clearinghouses and funds that are controlled by the network as their transfer is processed.

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<sup>67</sup> See Rachel E. Kranton, *The Formation of Cooperative Relationships*, 12 J. of L. Econ. & Org. 214 (1996).

<sup>68</sup> See Oliver E. Williamson, *Credible Commitments: Using Hostages to Support Exchange*, 73 Am. Econ. Rev. 519 (1983).

<sup>69</sup> For example, such a mechanism exists in the cotton industry. See Bernstein (2001), *supra* note 16, at p. 1737, footnote 69 (“In addition to paying the annual membership fee, members are required to purchase a membership in the Exchange. The By-Laws provide that when a member fails to pay an arbitration award, the prevailing party has a right to make a claim against his membership. If the noncomplying party still refuses to pay, his membership is auctioned off and the award is paid from the proceeds”), and p. 1768 (“...when a transactor is expelled from an association, he must forfeit his membership fee as well as other tangible benefits of association membership such as price sheets, technology circulars, and access to the group’s information services”).

<sup>70</sup> In ‘centralized control’ I mean the ability of the network to either monitor or direct activity over facilities used for transacting.

<sup>71</sup> There might be other incentives for centralized control of facilities and assets, besides efficient regulation. For example, creation or maintenance of market power may be facilitated by centralized control. See, e.g., *Pursuing a Remedy in Microsoft: The Declining Need for Centralized Coordination in a Networked World*, University of Chicago Law & Economics, Olin Working Paper No. 130 (available at: <http://www.law.uchicago.edu/faculty/picker/publications.html>; revised version forthcoming in Journal of Institutional and Theoretical Economics).



The primary effect of the control mechanism is preventative—control over network facilities allows the network to better monitor transactions for opportunism, and possibly prevent or modify these transactions. For example, transacting through Internet auction websites usually involves the use of centralized servers, controlled by the operator of the network. This control enables both monitoring by the operator for opportunistic (usually, fraudulent) behavior, and preventing transactions that are likely to be fraudulent.<sup>72</sup>

A fourth regulation enforcement mechanism which is employed by networks is the *Information Mechanism*—collecting and disseminating among members and nonmembers information on the credibility of firms (mainly firms that are members of the network). The information mechanism facilitates independent decisions by firms, whether to deal with a firm that the network reports as having acted opportunistically. This mechanism complements the exclusion mechanism, by expanding the scope of exclusion beyond members of the network, to nonmembers (and among the network members, to sanctions that are not imposed collectively by the network).

The information mechanism is not unique to networks. Independent firms invest in collecting information on potential business partners and may monitor their behavior. However, there are significant economies of scale to monitoring transactions, collecting and verifying information on trustworthiness, and private parties may have too small a transaction volume stake to justify extensive collection of information. Private information collection firms (such as credit rating agencies) can exploit these economies of scale just as well as networks, by specializing in monitoring and collecting information, and selling the information to many interested parties. Yet networks may have an advantage over information collection firms

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<sup>72</sup> On the actions of internet auction sites to combat opportunism see, e.g.: James M. Snyder, *Online Auction Fraud: Are the Auction Houses Doing All They Should or Could to Stop Online Fraud?*, 52 Fed. Comm. L.J. 453, 460-462

(regarding information on their members), particularly when their control mechanism is effective (*i.e.*, members transact mostly over the network's transacting facilities, and those facilities allow the network to monitor the transactions). Networks also have an interest in maintaining credibility among nonmembers, in order to induce the nonmembers to join the network's own decision to exclude a member (and therefore increase the magnitude of the sanction, deterring future opportunism). Therefore, networks are often able to efficiently induce nonmembers to follow the network's assessment of a member's trustworthiness.

### *3. Types of Opportunism in Network Environments*

Most of the literature regarding private ordering addresses opportunistic behavior that shares certain traits: There is a large benefit to the opportunistic party from defaulting on a specific transaction, there is a loss to the same party from potential future transactions that are affected by the default on the specific transaction, yet the benefit from defaulting on the specific transaction outweighs the losses in future transactions. This paper classifies opportunistic behavior that has these characteristics as *breach* (in order to distinguish it from another type of opportunism, which is described below).<sup>73</sup> A typical example of breach is failure to pay: the fraudulent party receives the good or service provided to it without incurring its cost, therefore gaining its value. It loses future transactions—most likely, all future transactions with the party which with it contracted, and possibly transactions with others who have heard of the fraudulent party's actions, or don't suspect the fraudulent party specifically, but have heard of the fraud and cease to deal with unfamiliar parties due to the increase in this risk. When the party chooses to

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(March 2000).

<sup>73</sup> Despite the term's implied relationship to breach in contracts or torts, opportunistic behavior of the 'breach' type need not involve a legal breach of duty or contract. Nor does it require certainty of, or intent to, default. For example, this paper would consider insolvency to be breach-type opportunism, since the potentially insolvent party gains from the specific transaction on which it defaulted, loses potential future transactions, and imposes losses on other parties on both the defaulted transaction, and on the lost future transactions.

defraud, it would be reasonable to assume that it expects the gain from the specific transaction it defaults on to be greater than the (discounted) aggregate loss of potential future transactions.

Breach is not the only type of opportunistic behavior in network environments. Another type of opportunism, which this paper calls *degradation*, is unique to network environments. Degradation is a predatory act that weakens the network, harming smaller firms more than larger ones, and therefore giving the larger firms an advantage over smaller competitors. One might view degradation as a form of the strategy known as raising rivals' costs,<sup>74</sup> adapted to prey on firms more dependent on network effects than the degrading firm.

Degradation has different characteristics than breach—when degrading, the payoff from defaulting on a specific transaction is negative. However, the default raises all the network members' risks of transacting over the network and therefore decreases network benefits, and the defaulting party stands to gain from the decrease in the efficiency of the network. This may be the case when a member of the network is much larger than other members. The demand-side economies of scale and scope, which characterize network environments, cause access to larger networks to be more desirable than to smaller ones. Therefore, members of a large network are advantaged in competing with members of smaller networks or with firms that are not members of any network. In networks containing both larger and smaller firms, the larger firms may gain from weakening the network and competing with the smaller members in conditions closer to those that would have existed had there not been a network.<sup>75</sup> This can be done by excluding others from their network<sup>76</sup> or by degrading connectivity with other members of the network.

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<sup>74</sup> On the strategy of Raising Rivals' Costs, see: Steven Salop & Scheffman, *Raising Rivals' Costs*, 73 *Amer. Econ. Rev.* 267 (1983).

<sup>75</sup> In most cases, the degrading firm is limited to depriving the other network members of the marginal network benefits attributable to the transactions contributed by the degrading firm. Only in rare cases could a degrading firm deprive other network members from network effects they confer on each other. In all other cases, victims of degradation still benefit from network effects created collectively by them. Therefore, unless the degrading firm is

For example, Goliath Corp. is a telephone company with a 70% market share. Goliath makes modifications to the facilities connecting it with other telephone companies, so that any call between a customer of Goliath and a customer of a competing company suffers from static noise. Calls in which both parties are Goliath customers, and calls not involving Goliath customers, are not affected. Betty is a customer of David Inc., a small competitor of Goliath. Approximately 70% of the people she calls are Goliath customers (correlating with Goliath's market share). This means that if she remains a customer of David, 70% of her calls will suffer from static noise. If she switches from David to Goliath, static noise will affect only 30% of her calls (those to nonGoliath customers). Therefore, Betty is likely to switch to Goliath. This is precisely the reason Goliath adopted a strategy of degradation—though the quality of its service suffers from the degradation (as 30% of the calls are of lower quality than before), it hurts the quality of the competitors' services much more (70% of their calls are affected, in our example). The migration of customers to the larger network compensates it for the loss resulting from the reduced quality of its own service cause by the degradation.

Similar strategies have been observed (or at least alleged), *inter alia*, in the credit card industry,<sup>77</sup> the Internet backbone industry,<sup>78</sup> and the telephone industry.<sup>79</sup>

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the only significant participant in the network, degradation usually cannot cause market conditions to be as if the network did not at all exist.

<sup>76</sup> See A. Douglas Melamed, *Network Industries and Antitrust*, 23 Harv. J. L. & Pub. Pol'y 147 (1999).

<sup>77</sup> See Amitai Aviram, *Accommodating a New Tenant in the House of Cards: Introducing Competition Into a Network Industry* (unpublished manuscript, 2002).

<sup>78</sup> See Cremer, Rey & Tirole, *supra* note 49.

<sup>79</sup> See, e.g., *Cavalier Telephone, LLC v. Verizon Virginia, Inc.*, 108 F.Supp.2d 608 (E.D. Va. 2002) (Entrant phone company alleges, among other things, that incumbent mis-routed its calls, provided inferior databases and web-based interfaces for ordering loops or last-mile facilities, made the process of ordering last-mile facilities (which it controlled) "lengthy, complex, and expensive," and intentionally made the billing process for loops costly for its competitors); *Goldwasser v. Ameritech Corp.*, 222 F.3d 390 (7<sup>th</sup> Cir 2000) (customers of incumbent telephone company allege, among other things, that incumbent "has failed to provide interconnection between its network and those of competitors that is equal to the interconnections it gives itself", that incumbent's competitors "have experienced undue delays (presumably caused by Ameritech) in acquiring unbundled elements, and those delays have precluded them from offering services as attractive as the incumbent's", and that incumbent "has continued to

With two exceptions noted below, degradation is likely to be a viable strategy only when the degrading firm cannot withdraw from the network (since withdrawal from the network would be the equivalent of absolute degradation—zero connectivity with the other (former) network members). Barriers to withdrawal from the network could be due to legal requirements (e.g., antitrust or regulatory mandates), or due to physical impracticability (for example, railroad companies cannot completely cut themselves out of a network, since the passengers could always walk from one railroad's terminal to the other's; however, they can degrade by refusing to share terminal facilities, by refusing to sell joint through tickets, etc.).

The two exceptions are: (1) When degradation is feasible against some network members but not against others (i.e., reducing connectivity will harm the degrading firm less than some network members, but more than other network members), it would weaken the degrading firm's competitive position against the less vulnerable firms. In these cases, the degrading firm would prefer selective degradation against the more vulnerable firms, while maintaining efficient connectivity with the less vulnerable firms. (2) When the degrading firm is less vulnerable than its rivals to some degradation, but more vulnerable to greater degrees of degradation. Network benefits are not necessarily directly proportional to the amount of connectivity, nor are they identical for all firms. It is possible that by reducing connectivity a little, the degrading firm will harm itself less than its rivals, but upon a greater amount of degradation (such as complete withdrawal from the network) the situation will reverse and the harm to the degrading (withdrawing) firm will be greater than the harm to the remaining network members. Naturally, if this is the situation, a firm may choose to degrade, yet not to withdraw from the network.

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bill customers of competitors who have converted from Ameritech's services, and hence some customers are being double-billed, thereby harming the competitors' good will").

Degradation is difficult to identify even when the actual behavior is observed, since the “correct” degree of connectivity is very difficult to determine.<sup>80</sup> To a significant extent, this is caused by poorly defined duties of connectivity. The ease of detecting breach depends (at least *inter alia*) on clearly defined property and contractual rights in the good or service in point. For example, we may observe Ann’s default on an obligation to Alice. It would be easy to identify whether this action is opportunistic breach if clear rules determine whether Ann’s obligation is binding. The laws of contract and property generally define rights to tangible property more clearly than antitrust and regulatory laws define rights to access another’s network facilities.

The looser definition of the latter is not due to neglect. It is difficult (particularly for an “outsider” such as a regulator or the courts) to assess what the efficient degree of connectivity should be, and this efficient degree varies widely with the peculiarities of each case. Imposing a duty of absolute connectivity would be meaningless; connectivity could always be enhanced (so degradation might take the form of inaction, or failure to upgrade connectivity when efficient connectivity requires upgrading). It is possible not to impose any duty of connectivity, and this policy would be clearly defined, but this rule would never prevent degradation, even when such strategy is feasible to a specific firm and harmful to social welfare.<sup>81</sup> Lacking a clear guide, courts and regulators often use the status quo as a benchmark, and perceive decreases from that level of connectivity as impermissible degradation.<sup>82</sup> While there is some merit to economizing

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<sup>80</sup> This paper assumes that the “correct” level of connectivity is the one that maximizes overall social welfare. While this is the mainstream presumption, it is by no means uncontested. Even if this standard is agreed upon, determining the correct level of connectivity is not simple.

<sup>81</sup> See Posner, *supra* note 4, at pp. 251-255 (demonstrating how an exclusion from a network may prolong the existence of a monopoly and therefore be both feasible to the incumbent monopoly and harmful to social welfare).

<sup>82</sup> See, e.g., *Aspen Skiing Co. v. Aspen Highlands Skiing Corp.* 472 U.S. 585, 105 S.Ct. 2847 (1985) (condemning a firm’s refusal to sell joint tickets with a smaller rival, after such joint tickets have been sold for several years). But cf. *Little Rock & Memphis R. Co. v. St. Louis, Iron Mountain & Southern R. Co.*, 2 I.C.C. 763 (E.D. Ark. 1890), *aff’d* 4 I.C.C. 854 (8<sup>th</sup> Cir. 1894). In this case, the St. Louis, Iron Mountain & Southern Railroad used to connect at Little Rock, AR with the Little Rock & Memphis Railroad. Upon completing a track of its own to Memphis,

on information costs by deferring to the presumed efficiency of the status quo, this rule of thumb may be misleading, especially in industries characterized by rapid change (as many network industries are). In such industries, change may affect the efficient level of connectivity, and yesterday's efficient level (which has been the status quo) may become inefficient. A connectivity benchmark based on the status quo may punish firms that adjust their level of connectivity to such changes.

While most networks face primarily either one opportunism type or the other, breach and degradation are not mutually exclusive. It is theoretically possible that some markets would be susceptible to both breach and degradation concerns.<sup>83</sup> Furthermore, in several industries, different aspects of the industry involve different opportunism types. For example, the credit card industry is concerned with dishonor (default on credit card payments) and fraud issues (which are of the 'breach' type). At the same time, in countries in which that industry consists of few issuers and merchant acquirers, larger issuers may attempt a degradation strategy (e.g., slow and error-prone processing of transactions between it and other issuers) to slow the expansion of smaller competitors.<sup>84</sup>

#### *4. Market Structure and Opportunism*

Market structure (e.g., the number and relative size of network members) significantly affects the type of opportunistic behavior an industry is prone to suffer from. Industries consisting of many small firms are likely to suffer from breach; industries consisting of a small number of large firms, and industries in which firms have a high vulnerability variance (i.e.,

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SLIM&S Railroad refused to honor through tickets to Memphis using the LR&M Railroad, instead carrying passengers to Memphis over its own lines. The court declined to prohibit this action.

<sup>83</sup> As discussed *infra*, in section II.5, the type of opportunism an industry is prone to suffer from is significantly affected by the market structure of that industry. Industries with characteristics that are conducive to both breach and degradation may be susceptible to both. For example, it is possible to envision a market with one large firm and many small competitors. The large firm may attempt to degrade against the smaller rivals, while the small firms may commit breach.

wide differentiation in the expected harm to each firm from opportunistic behavior), are likely to suffer from degradation.

The reason for the relationship between firm size and the type of opportunistic behavior is rather straightforward: A breach decreases connectivity and therefore reduces network benefits. Small network members who breach do not suffer as much from the reduction in such benefits (since the burden is divided among all members according to their share of the transaction volume, while the payoff from the fraud goes only to the breaching member). As for degradation, such a strategy is usually only beneficial to larger firms (smaller firms are likely to be disadvantaged, and possibly ineffective, when employing a degradation strategy, as they cannot effectively compete alone against larger firms, and they are not attractive for other firms to connect with).

The relationship between the vulnerability variance in an industry and the risk of degradation stems from the driving motive for degradation—raising the costs to one's rival more than the rise in one's own costs, in order to gain a competitive advantage over the rival, the value of which offsets the harm to oneself. Naturally, degradation is more profitable the greater the difference in vulnerability between the degrading firm and its victim. When all firms suffer the same harm from degradation, no firm will attempt to degrade, since it will not gain anything from it. As disparities in vulnerability to degradation increase, so does the payoff from degradation to the degrading firm. The greater the payoff, the more likely and more frequently degradation will occur.

Market structure has an effect not only on the type of opportunistic behavior the market is more susceptible to, but also on the ability of a network to regulate conduct in order to mitigate

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<sup>84</sup> See Aviram, *supra* note 77.



opportunism. This relationship will be explored below,<sup>85</sup> following a short examination of how opportunism, both breach and degradation, affects social welfare.

### *5. Social Welfare Effects of Opportunism in Network Environments*

Breach and degradation may differ in their effects on social welfare. The risk of breach raises the cost of transacting and therefore leads to a decrease in the number of beneficial transactions that take place. Furthermore, parties to the remaining transactions may take action to decrease the risk of breach, and the cost of these actions further decreases social welfare.

Complete prevention of breaches may result in the enforcement of some inefficient deals (since, if the network is successful in preventing all breaches, a member might not be able to "buy" its way out of an inefficient deal). However, there is good reason to believe that the regulator will be able to identify and allow efficient breaches.<sup>86</sup> Also, due to the degree of reliance on deals in a network (which increases the social cost of breach), efficient breaches are likely to be uncommon in comparison with inefficient breaches. Furthermore, a firm that repeatedly finds itself committed to inefficient deals can opt out of the network.

Assessment of the effects of degradation on social welfare is different. Degradation lowers the utility of interconnection or imposes costs on it, and therefore decreases network benefits. This reduced utility or added cost leads to a decrease in the number of beneficial transactions that take place on the network. This results in a loss not only to the parties that no longer find a transaction gainful after the added risk of degradation, but also to all members of the network who share in the loss of network benefits due to the decrease in transacting over the network. The added risk of degradation and the decrease in network benefits may cause some members to cease to transact through the network (perhaps seeking relative advantage by

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<sup>85</sup> *Infra*, sections III.3 and III.4 of this paper.

creating an alternative network in which members do not degrade, and perhaps withdrawing from the market because their small size does not enable them to compete). This reduction of transactions over the network further decreases network benefits, and where it results in less competition, also increases the dead weight loss. All of those effects reduce social welfare.

Not every unilateral reduction in connectivity is degradation. Some actions that reduce connectivity do not reduce net social welfare, and are not a form of degradation. Added connectivity is not always welfare enhancing. Like supply-side economies of scale, network effects may peak at a certain level. Above that level, more connectivity may reduce social welfare (e.g., due to the cost of the added complexity). Therefore, connectivity above the maximum efficient scale of the network may be welfare-reducing even if it is costless to enforce. Furthermore, preventing a reduction in connectivity has costs as well. A prohibition of any reduction in connectivity is akin to an open access requirement. Like open access mandates, a limitation on the ability to reduce connectivity decreases the incentive of network members to invest in growing, since the open access allows competitors to free-ride on their success. As a result, incentives to compete among network members decline.<sup>87</sup> Another concern with prohibiting degradation is that to make such a prohibition meaningful, someone needs to prescribe what is the ‘right’ level of connectivity, a decrease from which would be considered degradation. As discussed above,<sup>88</sup> the study and constant monitoring needed to assess the ‘correct’ level is very costly, and as with all forms of price or access pricing regulation, it is

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<sup>86</sup> The regulator may require a portion of the gain from the efficient breach in order to allow it. It would, however, be in its interest not to demand a portion so large as to induce the firm not to commit efficient breach.

<sup>87</sup> See *Little Rock & Memphis R. Co. v. St. Louis, Iron Mountain & Southern R. Co.*, *supra* note 82, at p. 765-6 (“Competing lines afford the best and surest protection the public can have against oppressive rates... Is it, under these circumstances, an unfair or unjust discrimination for the defendant in the sale of tickets to prefer its own lines to that of the plaintiff? If it is, the incentive to the construction of competing lines will be very much lessened.”).

<sup>88</sup> *Supra*, in part II(3).

subject to a significant risk of error and to (wastefully) expending resources on influencing the regulator.

Can government rely on the quality of connectivity prescribed by the network, and lend its enforcement mechanisms to impose those standards? This depends on whether networks treat welfare-reducing degradation differently from welfare-enhancing reductions in connectivity. At the time the alleged degradation takes place, the network is likely to condemn any reduction in connectivity regardless of its effects on social welfare, just as it doesn't distinguish between cheating a partner to a transaction and cheating a cartel (both formally seeming to be "breach", though the latter is welfare-enhancing and therefore not viewed as opportunism). However, at the time of forming the network and determining the duties of its members, network members are likely to determine an efficient level of connectivity (i.e., allow "efficient degradation", which is not degradation at all). There would still be a problem when changing circumstances modify the efficient level of connectivity. Absent government intervention, the network might renegotiate its obligations. But when private sanctions are ineffective, lack of government intervention would allow the large firm to degrade. Therefore, independent government assessment of the "correct" level of connectivity should be appropriate when: (1) the network is an inefficient regulator against degradation, either because it lacks the ability or the incentive to prohibit degradation; (2) circumstances have changed since the formation of the network so that the efficient level of connectivity may now be different; and (3) analysis of the practice indicates that it reduces social welfare.

### **III. Networks as Efficient Regulators**

#### *1. The Spectrum of Regulation*

As mentioned above, regulation can occur at different levels. At the level closest to the regulated transactions, the parties to the transactions may take measures to decrease opportunism. This may be referred to as *Transaction-Level Regulation*. Transaction level regulation includes relationship-building measures (such as bilateral bonds<sup>89</sup> or integration<sup>90</sup>), the use of third party guarantors,<sup>91</sup> etc. Transaction-level regulation benefits from the familiarity of the parties with the regulated transaction and their ability to monitor it closely, but suffers from weak sanctions against offending parties.

On the other end of the spectrum, furthest away from the regulated transaction, regulation may be attempted by the government. *Government-Level Regulation* benefits from relatively powerful sanctions, but monitoring costs (and the cost of error) are significant. Government attempts to reduce monitoring costs either by creating a specialized regulator or, more commonly, by allowing private rights of action (which utilize the lower monitoring costs at the transaction level and, after verification by a court or agency, allow the use of government-level sanctions).

Both techniques suffer from significant flaws. Regulators are very expensive, subject to capture, and even under optimal conditions have greater monitoring costs than the parties to the transaction. Private rights of action are subject to abuse, since regardless of their merit they impose costs (legal, reputational, temporal, etc.) on the defendant, and therefore may be used by a plaintiff manipulatively to extract a payoff from the defendant. Furthermore, the governmental verification system, usually a trial before a court, is imperfect, as Judges often lack the information, expertise or time to properly verify suits.

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<sup>89</sup> See, e.g., Kranton, *supra* note 67.

<sup>90</sup> See, e.g., Andy C. M. Chen & Keith N. Hylton, *Procompetitive Theories of Vertical Control*, 50 *Hastings L.J.* 573, 588-591 (1999).

<sup>91</sup> See Avery Wiener Katz, *An Economic Analysis of the Guaranty Contract*, 66 *U. Chi. L. Rev.* 47 (1999).

An alternative to both government-level and transaction-level regulation is *Network-Level Regulation*—the mitigation of opportunism by networks. Networks often have a monitoring ability comparable to (or surpassing) that of the parties to the transaction. Their strongest sanction—exclusion from the network—may be more deterring than governmental sanctions (especially if law enforcement is lacking or if a sanction of imprisonment is unlikely, as it is for many forms of opportunistic behavior in business).<sup>92</sup>

One advantage that some network-level regulation has over its government-level counterpart is in its ability to prevent some forms of opportunistic actions, rather than prohibit and punish as the government does. The control mechanism in some cases enables the network to intercept and block transactions that are deemed unwanted (e.g., eBay can delete listings of items which are illegal to trade on its website). The switching mechanism also prevents opportunistic behavior (in addition to deterring it), by preventing would-be victims from becoming captive to an opportunistic party. The exclusion mechanism, while punishing and deterring, also prevents opportunists from trading opportunistically in the future in industries where most trading is done on an exchange. The only similar remedy the government has is incarceration, which not only punishes and deters, but also physically prevents the opportunistic party from transacting in the future. However, as mentioned above, incarceration is unlikely to be imposed for most forms of opportunistic business behavior. Another government remedy—injunctive relief—while intended to prevent (rather than merely deter or punish) behavior, is not a barrier in itself to an action, but merely a threat of court sanction if the order is violated. As such, additional enforcement costs are required to enforce the injunction (e.g., detection of the violation, proving the violation in

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<sup>92</sup> Few forms of opportunism are punishable by incarceration. Not all outlawed opportunistic behavior is criminal; some give rise only to civil sanctions. Even among criminal opportunistic behavior, very often the offender is sentenced to a fine, rather than imprisonment. The criminal system deals with many forms of harmful behavior,

contempt proceedings, etc.). Even then, to prevent a given conduct the penalty must either be incarceration (as fines would merely put a price tag on the violation), or it must be targeted not at the violator but at a private entity that has the ability to physically prevent conduct (e.g., requiring eBay to delete listings of illegal items). The former alternative is unlikely (violators of injunctions who do not pose a physical threat are rarely incarcerated); the latter merely commandeers network-level regulation.

Forms of regulation that physically prevent a would-be opportunist from acting in a harmful way (rather than deterring or punishing such behavior) can be analogized to rules of physics, which unlike rules of law, cannot be broken. The possession of such ‘rules of physics’ gives networks a significant advantage over other potential regulators. Like rules of physics, however, these mechanisms are difficult to artificially create—they will not exist if efficient market structure dictates that a given network does not have the ability to track and block transactions, or if many transactions in a given industry are done outside of networks. In contrast to rules of physics, rules of law are easier to artificially impose where they did not exist before.<sup>93</sup>

Another advantage that some networks possess is a common culture shared by members. Common culture reduces costs involved in regulation in several ways. It widens the scope of services provided by the network to include social gratification. Therefore, the deterring cost of exclusion from the network is greater (as it includes not only loss of business with network members, but also loss of social standing). Common culture also provides members with knowledge about matters relevant to the business transacted over the network, and standardizes this knowledge among the network members, thus reducing information asymmetry. Further, a

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many of which threaten society more than opportunism does. Since sanctions are determined in proportion to the severity of the crime, the most deterring of government sanctions are rarely used against opportunism.

common culture creates a unique good—esteem (social standing in the group), which can be a powerful motivator to follow the norms of the group (including refraining from opportunistic behavior against other group members).<sup>94</sup> Common culture may also add a psychological element to the mitigation of opportunism, as opportunism towards one’s social group (and with which one empathizes or identifies) may be perceived by oneself and by others as more morally wrong than opportunism in a pure business context. Furthermore, membership in a network may induce a sense of kinship that would both increase guilt when acting opportunistically against one’s ‘kin’, and eliminate the ability to justify opportunism with an antipathy to ‘outsiders’.<sup>95</sup> For all these reasons, common culture reduces regulation costs.

It is therefore unsurprising that networks (and other institutions) have attempted to create common cultures that facilitate the underlying business transactions.<sup>96</sup> Part of the value in belonging to a common culture, however, is the difficulty in artificially producing it. The difficulty in finding or creating an alternative, equally attractive social group is what makes membership in the current group so valuable. It is difficult to create a common culture where there was none before, but if an existing cultural network exists, it may expand its role and act to mitigate opportunism in business transactions, exploiting its enhanced ability to regulate. As

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<sup>93</sup> For an extensive discussion of regulation through “rules of law” and “rules of physics” see: Lawrence Lessig, *Code and Other Laws of Cyberspace* (1999). Lessig uses the term “code” to regard the various “rules of physics” methods of regulation.

<sup>94</sup> See: Richard H. McAdams, *Cooperation and Conflict: The Economics of Group Status Production and Race Discrimination*, 108 Harv. L. Rev. 1003 (1995).

<sup>95</sup> On guilt alleviation as an incentive to cooperate (and reciprocate good behavior) see: Lior Strahilevitz, *Charismatic Code, Social Norms, and the Emergence of Cooperation on the File-Swapping Networks*, 89 Va. L. Rev. \_\_\_\_ (forthcoming 2003), at section III.D.1.

<sup>96</sup> See, e.g., Bernstein (1998), *supra* note 12, at p. 110 (“They [trade associations – A.A.] have also encouraged the emergence of informal information channels by creating opportunities for social interaction among members and their families. Many associations sponsor clubs for spouses and host regular sporting events and gala dinners... They also link social reputation to commercial reputation, thereby increasing the cost to transactors of sacrificing reputation bonds and giving them stronger incentives to abide by their commercial commitments”); Bernstein (1992), *supra* note 12, at p. 130 (“Another enforcement mechanism sometimes invoked by the arbitrators is a proceeding in Jewish rabbinical courts against the party who refuses to comply. Because these courts have the

addressed in the next section, when networks have the ability to be the efficient regulators, they often reform to accept that role.

Regulation at each level is not mutually exclusive with other levels. Very often each level relies on regulation of some aspects by another level, while it regulates those aspects in which it is most efficient. For example, transaction-level regulation very often operates “in the shadow of the law”, efficiently mitigating opportunism in transactions with lower value, while relying on the ability to sue in court for opportunism in higher-value transactions (in which the costs and delays of the government-level regulation do not dissipate most of the value of the dispute).

However, to a certain extent, each level of regulation may weaken the ability of another level to regulate. Network regulation is often biased by the existence of government regulation, because activities may now be aimed at either appeasing the government regulator or ‘capturing’ him, either of which may diverge from the course of action needed to efficiently mitigate opportunism. Where government-level regulation is more efficient, but the government lacked the means to enforce its regulation (as is the case in some developing countries, and sometimes in certain areas of developed countries) network-level regulation may become redundant when the government increases enforcement.<sup>97</sup> Likewise, network-level regulation can reduce the effectiveness of transaction-level regulation by decreasing the quality of partners to bilateral contracting (who remain outside the network).<sup>98</sup> The reverse is also true - transaction-level regulation may reduce the effectiveness of network-level regulation, by diverting transactions away from the network, and therefore decreasing the effect of the exclusion and switching

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authority to ban an individual from participation in the Jewish community, this is a powerful threat against Orthodox members of the diamond industry.”). *Also see* Landa, *supra* note 22.

<sup>97</sup> *See* McMillan & Woodruff, *supra* note 23 (discussing network-level regulation in the face of poor law enforcement by the government); Milhaupt & West, *supra* note 16 (discussing organized crime (which is a form of network-level regulation) when law enforcement by the government is lacking).

<sup>98</sup> *See* Kali, *supra* note 22.



mechanisms (due to a decrease in network benefits) and the control and information mechanisms (due to lack of network control over the bilateral transactions).

Below I will discuss when network-level regulation is the optimal level to regulate. This depends on the network having comparative advantages in both the incentive and the ability to regulate. When either is not the case, other would-be regulators develop to displace the network, unless the network adapts to improve its incentive or ability. This qualification, as to a network's ability to adapt, will be addressed first.

## *2. Networks' Resilience—Middleware as an Adaptation*

As noted above,<sup>99</sup> there is a demand for efficient regulation. This allows networks to displace other institutions (such as the parties to the transaction or government) when the former institution is the more efficient regulator. Similarly, when networks are not efficient regulators, demand for regulation creates pressures to replace the ineffective network with other institutions. However, networks are very resilient, and often adapt in response to demand for regulation, to a form that is better suited to mitigate opportunism.

This adaptation often takes the form of an institution recent antitrust case law and literature has called '*middleware*'.<sup>100</sup> Middleware is a facility that connects to independent networks in order to maintain access between those networks. It can be analogized to a hub, the spokes of which are independent networks and the purpose of which is to combine the independent spokes into a single network.

Middleware has been discussed in depth in the context of the Microsoft trial. In that context, the middleware was software (such as Sun's Java and Netscape's Navigator) that could

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<sup>99</sup> *Supra* section I.

<sup>100</sup> *See, e.g.*, Howard A. Shelanski & J. Gregory Sidak, *Antitrust Divestiture in Network Industries*, 68 U. Chi. L. Rev. 1 (2001); *United States v. Microsoft Corp.*, 87 F.Supp.2d 30 (D.D.C. 2000), *aff'd in part, rev'd in part* 253

operate on various operating systems, while allowing application developers to develop applications operating on it. An application written for the middleware would then operate on any of the various operating systems that the middleware supported. Thus, the middleware connected independent networks (operating systems), allowing one application to operate on all.

Much of the discussion in the discussion in the Microsoft trial and in the literature that analyzed middleware in the aftermath of that trial examined the effects of middleware on market power and market definition. Market power may be a cause to the demand for middleware, because it biases the existing network's incentive to regulate efficiently. But there may be other reasons for the emergence of middleware (such as limitations to the current networks' ability (rather than incentive) to regulate). A key utility of middleware is its ability to ensure efficient connectivity between formerly independent networks.<sup>101</sup>

It seems that one of the benefits of the middleware discussed in the Microsoft trial (though certainly not the only benefit and perhaps not the most important one), was its ability to allow a single application to operate on several operating systems. Arguably, the market power possessed by Microsoft's Windows operating system biased its incentive to regulate efficiently (perhaps instead giving it an incentive to attempt to maintain or enhance their market power, for example by excluding or degrading). The middleware (Java and Navigator), on the other hand, did not suffer from this bias, and could more efficiently regulate.

Middleware may also emerge when existing networks lack the ability to properly regulate. This seems to have been the case, for example, with an older type of middleware—Express Companies. These companies formed in the mid-nineteenth century, when traveling a

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F.3d 34, 53-4 (D.C. Cir. 2001), *cert. denied* 122 S.Ct. 350, 151, L.Ed.2d 264 (2001) (hereinafter: "the Microsoft trial").

<sup>101</sup> Middleware often has other, functional utilities that have nothing to do with regulation. For example, the Internet browser serves as an interface between the user and the internet.

significant distance by train required connecting through many small railroads. A small number of railroads operated in each region, making a regional network less effective as a regulator.<sup>102</sup> Express companies took upon themselves to deliver freight, and coordinated among the railroads that carried that freight. As Dennis Carlton and Mark Klammer point out,<sup>103</sup> express companies offered this coordination until railroad companies consolidated and were able to offer comparable coordination.

The resilience of networks is not without limits. As discussed above,<sup>104</sup> network effects may raise to some extent barriers to entry, and therefore some “biased” networks would not be replaced by smaller, unbiased alternatives. However, even if proponents of inefficient lock-in are correct in their analysis, the barriers to entry raised by network effects are not infinite, and therefore a concern on the part of biased networks of being replaced by nonbiased alternatives serves as a check on the degree to which they use their ability to regulate in a manner that is socially inefficient.

It is also important to note that middleware is not necessarily welfare enhancing. For example, it may free-ride on investments in the independent networks it connects. However, where network-level regulation can be efficient, yet the existing network lacks the incentive or ability to regulate efficiently, middleware is likely to appear in response to demand for welfare enhancing regulation.

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<sup>102</sup> As discussed *infra*, in section III.4, high concentration (i.e., a market composed of a few large firms) reduces the ability of a network to regulate. It is noteworthy that there was another obstacle to self-coordination by the railroads, due to a possible bias in incentives caused by possession of market power. There were not many railroads competing from any given destination, and therefore many of the railroad companies possessed some market power

<sup>103</sup> Dennis W. Carlton & J. Mark Klammer, *The Need for Coordination Among Firms, With Special Reference to Network Industries*, 50 U. Chi. L. Rev. 446, 457 (1983) (“Some of the uniform operating procedures were spurred by outside competition. During the thirty-year period beginning in 1850, independent freight companies, such as Wells Fargo, began to serve as intermediaries between railroads and customers who desired to ship goods. These freight companies handled the complicated transactions with all the different railroads... By the 1880's, the railroads had little need for freight express companies.”). On consolidation as a response to the need for greater coordination

### 3. Networks' Incentive to Regulate

Opportunism, broadly defined, is “an act in which someone destroys part of the cooperative surplus to secure a larger share of it”.<sup>105</sup> Regulation is aimed at mitigating opportunism, yet no potential regulator has the incentives to always deter opportunism. Parties to the transaction are directly affected by any opportunism targeted at them, but do not care about the effects on others. Therefore, they do not have a sufficient incentive to regulate efficiently when opportunism imposes externalities on others, and they might even regulate in a way that benefits them but harms others (as may be the case with cartels, group boycotts, etc.).

Government has broader incentives, usually extending to the interests of all of its constituents. However, the incentives are indirect. As public choice theory observes, the interests of certain constituents influence government more than others. Government may also have other interests besides mitigating opportunism, which might contradict with efficient anti-opportunism enforcement.<sup>106</sup>

Networks have similar incentives to those of the parties to the transaction. Being a larger group, the array of interests networks are concerned with is wider than that of transaction-level regulators. Unlike the government, the network is directly affected by opportunism, since opportunism usually decreases network benefits, reduces activity and reliance on the network. Like transaction-level regulators, networks may disregard, or even exploit, the interests of

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see Alfred D. Chandler, *The Visible Hand: The Managerial Revolution in American Business* 81-82, 89 (Harvard, 1977).

<sup>104</sup> *Supra*, text relating to notes 38-43.

<sup>105</sup> Cooter, *supra* note 5, at p. 150.

<sup>106</sup> For example, as mentioned before, government's interest in deterring violent crimes, and the need to assign sanctions in proportion with their gravity, requires that government not use its most powerful sanctions against persons who act opportunistically in business transactions (since this is considered a significantly less serious crime than murder or rape). If private parties can rely on the government's deterrence of more serious crimes, they will impose the strongest sanctions they have against less serious, but still harmful, behavior such as opportunism in business transactions.

nonmembers. The literature has termed this as the “dark side of private ordering”.<sup>107</sup> For example, some networks discriminate on the basis of race, ethnicity, gender, or other characteristics; in certain cases (typically, where government-level regulation is lacking), networks utilize physical violence as a sanction. More commonly, they may attempt to create, enhance or maintain the market power of their members.

The possession of market power by a network, or of the ability to maintain that market power, significantly biases the network’s incentives. The same mechanisms that are used to mitigate opportunism can be used to facilitate collusion. From the perspective of the network members (but not, of course, from the perspective of overall social welfare) cheating on a cartel agreement is no different from defrauding—both reduce the network members’ benefit, and the prevention of both is beneficial to the network.

Pirrong points to other potential biases that may cause networks to lack the incentive to regulate in a socially efficient manner.<sup>108</sup> First, collective action problems and rent seeking among network members impairs incentives to self-regulate. Second, some types of opportunism mainly affect inframarginal customers of the network, while the network members’ wealth depends on the marginal customers.<sup>109</sup> The strength of these arguments seems to be highly

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<sup>107</sup> See: Milhaupt & West, *supra* note 16; McMillan & Woodruff, *supra* note 23, at p. 2454-2458; Ellen D. Katz, *Private Order and Public Institutions*, 98 Mich. L. Rev. 2481, 2482-2485 (2000).

<sup>108</sup> Stephen Craig Pirrong, *The Self-Regulation of Commodity Exchanges: The Case of Market Manipulation*, 38 J. L. & Econ. 141 (1995).

<sup>109</sup> Pirrong makes two other arguments as well: (a) networks may not face significant competition and therefore may lack the incentive to improve efficiency in transacting through them; and (b) there is a significant negative externality on nonmembers who rely on price information from transactions on the network. Both of these arguments seem difficult to defend.

The argument regarding lack of competition among networks is unconvincing because even if a network faces no competition, it would still view opportunism that harms its customers as a cost, rather than a monopolistic rent (unless it profits the network itself, which would make the “opportunistic” action an exploitation of market power by the network, rather than an opportunistic act done over the network). If opportunism is a cost, a monopolist would have an incentive to mitigate it and replace it with outright extraction of monopolistic rent (as long as the cost of mitigation is lower than the loss of profits from the decline in demand due to this cost). However, one instance in which this would not be the case is when the network is regulated by government and limited in its ability to receive payments from its customers. In this case the monopolist would have no incentive to diminish

dependent on the characteristics of the specific network (Pirrong's focus was on commodity exchanges). Even in instances where they have validity, this only means that networks are imperfect regulators. As seen above, government—as well as any other potential regulator—suffers from imperfections in its incentives and ability to regulate, and therefore networks may be the most efficient regulators even where they suffer from some bias in their incentives.

Furthermore, as mentioned above,<sup>110</sup> networks adapt to biases that hinder regulation by evolving through middleware into a network with either decentralized control or centralized control by a firm that does not possess market power (both alone or with others in the network).<sup>111</sup> Typically, this is because the “hub” firm that controls the expanded network does not operate in the industry in which the market-power possessing members operate—an express company in the hub of a network of railroads; a programming language in a hub of a network of operating systems, etc.<sup>112</sup>

#### *4. Networks' Ability to Regulate*

The mechanisms that networks use to regulate—the switching mechanism, the exclusion mechanism, the control mechanism and the information mechanism—were described above. The effectiveness of these mechanisms, and therefore the effectiveness of the network as a regulator, is dependent on market structure.

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opportunism. Furthermore, in the case of such regulation, to the degree that this opportunism is beneficial to the network members, the network might favor opportunism, as a form of “gold plating” evasion of regulatory caps on rent extraction. But this seems not to be the common case of most networks.

Regarding the reliance on price information – nonmembers should, and probably do, take into account the degree of opportunism policing when they decide whether and to what degree to rely on the network or the information generated by it. If a network lacks an incentive to self-regulate efficiently, nonmembers will seek another, more accurate indicator; rely less on the price information; or pay the network in order to self-regulate (assuming the network is the institution with the best ability to mitigate opportunism).

<sup>110</sup> *Supra*, section III.2.

<sup>111</sup> The network possessing market power may attempt to prevent middleware from forming or from connecting to the network, since it benefits more from maintaining its market power than from enhancing regulation.

<sup>112</sup> Perhaps the popularity of industry-sponsored networks in some industries, and of independent networks in other industries, may be explained by the need (in the latter group of industries) to create a network that is free of market

The effectiveness of a network's switching mechanism is greater in markets that are characterized by significant network benefits and low concentration. As concentration rises, the market becomes more susceptible to collusion (so the network's prices are less likely to mimic a perfectly competitive market) and fewer alternative firms are available to contract with when a transaction fails.

Similarly, the effectiveness of a network's exclusion mechanism is greater in markets that are characterized by significant network benefits and low concentration. The greater the network benefits, the greater the value conferred on the network member, and therefore the greater the cost of canceling the membership in the network.<sup>113</sup> Larger firms, however, are less threatened by exclusion. First, the larger the firm, the greater the loss to the network from its exclusion (since the size of the network decreases significantly, and with it the network benefits). The network's threat of exclusion is less credible the greater the loss it suffers from the exclusion. Second, some firms may be large enough to become indispensable to other firms, and therefore exclusion from the network may force those dependent members to contract with the excluded firm. This both decreases the transactions processed through the network (further harming network members) and decreases the amount of business the excluded firm is deprived of. Third, as mentioned above,<sup>114</sup> large firms may actually find it profitable to adopt a degradation strategy, under which the firm weakens the network in order to gain an advantage in competing against smaller firms. Exclusion from the network is the ultimate form of degradation (since it degrades

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power bias in the incentive to regulate. The issue may warrant significant additional attention, which exceeds the scope of this paper.

<sup>113</sup> For a similar point, see Bernstein (1998), *supra* note 12, at p. 111, citing Benjamin Klein & Keith B. Leffer, *The Role of Market Forces in Assuring Contractual Performance*, 89 J. Pol. Econ. 615 (1981) ("When market transactors share a common view about what constitutes acceptable business behavior, a given instance of misbehavior will result in more transactors imposing the sanction. It gives transactors an added incentive to abide by their commercial commitments by making it in each transactor's individual best-interest to perform rather than breach over a wide range of contingencies and market conditions.").

<sup>114</sup> See Cremer, Rey & Tirole, *supra* note 49, and section II.3 of this paper.

to nothing the connectivity with the excluded firm), and therefore would be a boon, not a bane, to large firms that benefit from degradation.<sup>115</sup>

The information mechanism is an extension of the exclusion mechanism and decreases in effectiveness in similar situations: Private parties are less likely to boycott larger firms, even if provided with credible information by the network, because the harm from boycotting a larger firm tends to be greater. Specifically, large firms tend to have more captive partners, who find it very costly to switch away from the large firm, and are therefore less likely to do it.

Finally, the control mechanism is also more efficient in markets that are characterized by significant network benefits and low concentration.<sup>116</sup> The control mechanism is effective when the network's transacting facilities cannot be feasibly replaced by opportunistic members. If the transacting facilities can be replaced easily, then the opportunistic members can do so immediately before behaving opportunistically (to evade the network's ability to monitor and prevent the behavior), or immediately after behaving opportunistically (to null the effect of the network's denial of access to the facilities). Creating independent transacting facilities has the same effect as being excluded from the network, and therefore the effects of network benefits and firm size on the effectiveness of the control mechanism are the same as those mentioned in the discussion above on the exclusion mechanism: The greater the network benefits conferred by the network, the larger the difference between it and any alternative facility created by the opportunistic member.

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<sup>115</sup> Some large firms do not benefit from degradation, because network benefits gained from operating within the network outweigh the possible benefits of competing against a degraded network. For such firms, the third argument regarding the effectiveness of the exclusion mechanism would not apply, and perhaps the threat of exclusion will deter them from breach. However, the other two arguments (regarding the credibility of the threat to exclude and the 'stranded partners' that cannot stop transacting with the firm) still apply, and may weaken the networks ability to discipline that firm's behavior.

<sup>116</sup> Some networks have a decentralized structure that does not involve centralized control of transacting facilities, in which case the control mechanism will not be available regardless of network benefits or the size of firms in the market.



In sum, networks' ability to regulate should increase as network benefits rise and the size of the firms in the market decreases.

### *5. Summary - Market Structure and Opportunism Revisited*

As discussed in section II.4 of this paper, markets with low concentration (containing many small firms) are prone to suffer from breach type of opportunism, while markets with high concentration and high vulnerability variance are likely to suffer from degradation. Section III.4 observed that networks are likely to be efficient regulators (given the incentive to do so) in markets characterized by significant network benefits and low concentration.

A very brief and preliminary look at a few network industries seems to support these expectations. The diamond exchange industry, the cotton exchange industry, and Internet auction websites all involve many, relatively small firms, and significant network benefits. It seems the main opportunistic threats these industries are concerned with are of the breach type (primarily fraud and insolvency). In these circumstances, networks are expected to be good regulators. Indeed, networks take active roles in monitoring, deterring and punishing breach in each of these industries.<sup>117</sup> Government-level enforcement is not as intensive; none of these industries is closely regulated, and though the FTC is active in prosecuting internet fraud, the larger Internet websites (such as eBay) are take a leading role in instituting anti-fraud mechanisms.<sup>118</sup>

On the other hand, the Internet backbone industry and the credit card industry (in certain countries) tend to be dominated (in each relevant geographic market) by a few large firms. So was, in many regions, the preregulation (i.e., 19th Century) American rail industry.<sup>119</sup> In these

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<sup>117</sup> See Bernstein (1992), *supra* note 12; Bernstein (2001), *supra* note 16; Snyder, *supra* note 72.

<sup>118</sup> See Snyder, *supra* note 72.

<sup>119</sup> The 19<sup>th</sup> Century rail industry is examined, rather than the contemporary one because regulation (which was significantly increased in the late 19<sup>th</sup> Century and early 20<sup>th</sup> Century) affects the industry structure. Therefore, the industry structure observed in a regulated industry may have more to do with a regulator's presence and preferences than with private ordering.

industries, degradation (rather than breach) is expected to be the primary concern.<sup>120</sup> Networks would also be expected, in these circumstances, to be poor regulators, and therefore networks should be less prevalent in the industry than collections of bilateral or small multilateral connections, that can be governed by transaction-level regulation.<sup>121</sup> The framework discussed in this paper would also predict that the industry would be less resistant to government regulation, since government-level regulation would be more effective than the network-level counterpart. Indeed, all these industries are regulated by government, and at least in the rail industry, scholars indicate that government regulation was welcomed by the railroad companies.<sup>122</sup>

This is but an initial observation. The analysis offered in this paper provides guidelines to future detailed empirical examination of the utilization of network effects in creating institutions that mitigate opportunism.

To what extent does the existence or absence of a network as a regulator affect market structure? For the most part, the existence or absence of a network-level regulator (but not of network effects) is exogenous to the market structure. Market structure is primarily shaped by characteristics such as barriers to entry, the existence of network effects or supply-side economies of scale, etc. Government-level regulation may also affect market structure (for example, by creating barriers to entry).

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<sup>120</sup> See Cremer, Rey & Tirole, *supra* note 49 (regarding degradation concerns in the internet backbone industry); Aviram, *supra* note 77 (regarding degradation allegations in the Israeli credit card industry).

<sup>121</sup> For a discussion of the circumstances in which transaction-level regulation is preferable to network-level regulation (in the context of the natural gas industry) see: Thomas P. Lyon & Steven C. Hackett, *Bottlenecks and Governance Structures: Open Access and Long-term Contracting in Natural Gas*, 9 J. L. Econ. & Org. 380, 384-385 (1993).

<sup>122</sup> See Gabriel Kolko, *Railroads and Regulation 1877-1916* (Norton, 1970); Susan Perviant Lee & Peter Passell, *A New Economic View of American History* 324-325 (Norton, 1979); Paul MacAvoy, *The Economic Effects of Regulation* (MIT, 1965).

Network-level regulation, however, due to its resilience,<sup>123</sup> may not have significant long-lasting effects on market structure (i.e., the existence of inefficient network-level regulation, or absence of such regulation where it would have been efficient, will not significantly affect market structure), because: (a) to the extent that network-level regulation evolves into an inefficient system (or market conditions change in a way that renders inefficient a formerly adequate network-level regulator), self-correction through defection from the network (and possibly the formation of a more efficient, alternative network-level regulator) will most likely weaken it much before the existence of inefficient regulation could change market structure; (b) in the inverse case, where network-level regulation would be efficient but does not currently exist, a network-level regulator may be expected to evolve if unless government-level regulation prevents it (in which case, the determinant of market structure would be government-level regulation, not the lack of network-level regulation).

This analysis requires two caveats. First, point (a) could be wrong if there is a significant ‘lock-in’ effect keeping an inefficient incumbent network from withering or being replaced by more efficient “middleware”.<sup>124</sup> For example, a monopolist network that locks in because it offers far greater network effects than any entrant network, may have market power-driven biases that prevent it from regulating effectively. If it remains in place for a long period, its actions may affect market structure (e.g., it may erect barriers to entry, or raise concentration in the industry). But a monopolistic network would unlikely enjoy both monopolistic rents and longevity: the competitive advantage conferred on it by the network effects can be used to deter entry of competing networks (by regulating efficiently), or to regulate inefficiently for a short time (gaining monopolistic rents, but likely declining before market structure can be permanently

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<sup>123</sup> See *supra*, Section III.2.

affected). As discussed above, inefficient networks invite the creation of middleware, which eventually displaces the market power-driven network.<sup>125</sup> Therefore, the lock in qualification to point (a) is not of significant effect on market structure.

Second, both points (a) and (b) impliedly assume a spontaneous creation of network-level regulators in response to a demand for such regulation. The creation of private legal systems is often not spontaneous, but rather develops in phases.<sup>126</sup> Impediments to the creation of private legal systems may slow the entry of network-level regulators, and if this delay is long enough, it may force parties to enter into transaction-level regulation, including horizontal and vertical integration that affects market structure. For example, excessively strict antitrust regulation may prohibit welfare-enhancing information exchanges or trade association rules that reduce opportunism. The lack of such private regulation may force firms to merge (horizontally or vertically) to ensure risk-free transactions in what has become a riskier transacting environment.<sup>127</sup> Usually, however, the obstacles to the development of the private regulator stem from government-level regulation, making it, rather than the network-level regulation, the cause of modification in market structure.

#### **IV. Conclusion**

Transactions are subject to risks of opportunistic behavior. Many transactions take place in environments that contain ‘networks’ - institutions characterized by network benefits. In such environments, networks compete with the parties to the transaction and with entities external to the network (primarily the government and creators of middleware) in providing regulation (instituting mechanisms that mitigate opportunism).

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<sup>124</sup> For discussion on the plausibility of a “lock-in” effect resulting from network effects *see supra*, text relating to notes 38-43.

<sup>125</sup> *See supra*, Section III.2.

<sup>126</sup> Amitai Aviram, *NonSpontaneous Evolution of Private Legal Systems* (Unpublished project summary, 2003).

Networks employ four mechanisms to decrease opportunism: a switching mechanism (efficient replacement of failed transactions with alternative ones); an exclusion mechanism (depriving a member of access to the network); a control mechanism (centralized control of transacting facilities and other members' assets); and an information mechanism (collection and dissemination of information on the credibility of firms, in order to facilitate independent decisions on the feasibility of transacting).

In a network environment, two types of opportunistic behavior can be distinguished: Breach is a transaction-specific default in which the large positive payoff at the time of default outweighs future gains lost due to the default; Degradation is a strategy of defaulting not for immediate gain, but in order to weaken the network, in anticipation of long-term benefits to the defaulting party from the absence (or decreased effect) of the network. Market structure (e.g., the number and relative size of network members) affects the type of opportunistic behavior the network is prone to suffer from. Markets composed of many small firms are more susceptible to breach, while markets containing a few large firms with high vulnerability variance are susceptible to degradation.

Market structure is also a key factor in determining the network's utility as a regulator relative to regulation by other entities, since it affects the effectiveness of these mechanisms and the type of opportunistic behavior the network is prone to suffer from. Networks in markets consisting of many small firms possess a powerful exclusion sanction and are likely to offer a viable switching mechanism and effective control and information mechanisms. As a result, in such markets regulation by the network displaces regulation by the government or the parties to the transactions. On the other hand, networks in markets that consist of a few large firms have weak sanctions against opportunistic firms and are less likely to facilitate effective switching,

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<sup>127</sup> *Id.*

control and information mechanisms. Therefore, in these circumstances networks are displaced by government, gatekeepers or the parties to the transaction in regulating. Networks, however, are resilient, and when they are not the efficient regulators they often reform (commonly, through the emergence of middleware) to a structure in which they have both the incentive and the ability to regulate.

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