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ONE-WAY NETWORKS, TWO-WAY NETWORKS, COMPATIBILITY, AND PUBLIC POLICY

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1. INTRODUCTION

Network industries are common: telephone, Automatic Teller Machines (ATMs), railroads, roads, and electricity are just a few examples. An examination of some important public policy aspects of network industries requires a deeper understanding of the concepts of "compatibility" and "network externalities" and especially the role they play in determining market conduct and structure.[1] This analysis leads us to conclude that compatibility and a form of network externalities play a similar role in non-network industries as long as there are significant complementarities between types of goods. This similarity allows us to utilize the significant volume of economic and legal thought on vertical relations to analyze antitrust and related regulatory problems for network industries.

2. COMPATIBILITY AND NETWORK EXTERNALITIES IN NETWORK INDUSTRIES

2.1 Two-way Networks

To establish our framework, let us first consider the simplest possible network: a central switch S with n spokes, SA, SB, SC, etc., as in Figure 1. If this is a telephone network, customers are located at A, B, C, etc., and the goods are phone calls ASB, BSA, ASC, CSA, etc. Each good, such as ASB, is composed of two complementary components, AS and SB, each of which can be thought of as "access to the switch."

A number of observations are in order. First, *all* components (AS, BS, etc.) are complementary to each other. Therefore any two of them can be connected to make a demanded composite good (such as ASB). Second, components AS, BS, etc., are complementary to each other despite the fact that in industrial specification terms they are very similar goods. Third, there is reciprocity or reversibility. Both ASB and BSA are feasible but different (though technologically very similar) because the spokes AS, BS, etc., can be traveled in both directions. Fourth, customers tend to be identified with a particular component. Fifth, composite goods that share one component, such as ASB and ASC, are

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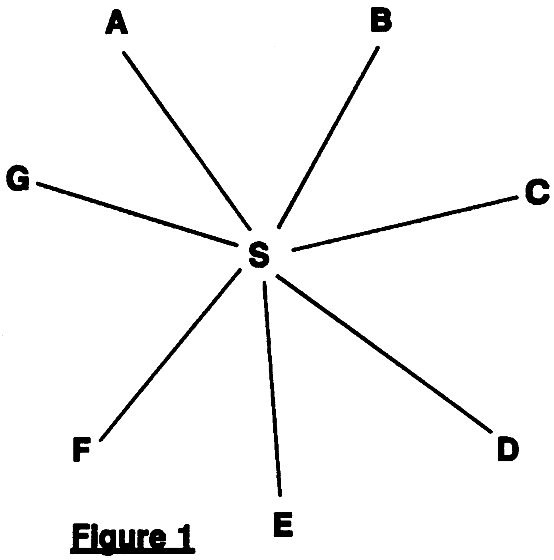

Figure 1

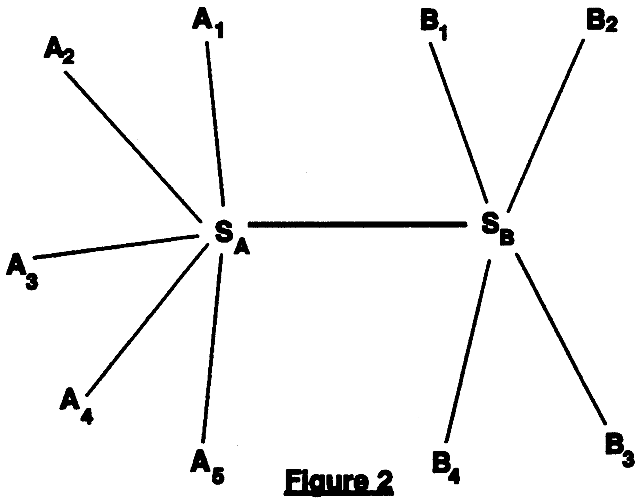

Figure 2

not necessarily close substitutes. Sixth, there are *network externalities*: the addition of a new spoke to an n-spoke network creates 2n new potential goods. The externality takes the form of the creation of new goods for each old customer.[2] We could call it *an economy of scope in consumption*. Note that the *externality affects directly the utility function of each consumer*. There may be other secondary (indirect) effects through the markets (such as price changes), but this is not necessary or essential. Seventh, we have assumed in the definition of the network that its components are *compatible*, so that their combination is of value. Compatibility may be automatic for certain goods (for example, sugar always dissolves in coffee), but for high technology products it has to be achieved by explicit or implicit agreement on certain *technical standards*.

Two-way networks, such as telephone, railroad, road, and electricity, exhibit most of the features of this simple example. In particular, they exhibit complementarity between most components of the network, reciprocity, identification of particular consumers with nodes, no close substitution between composite goods that share a component, and network externalities.[3] The feature that disappears in more complicated networks is the complementarity between any two components of the network and the symmetry of the externality.

Now consider a slightly more complex network in Figure 2. A gateway S_AS_B connects two different switches S_A and S_B, which are the central nodes of two star networks. Let all spokes starting from S_A end at points A_1, A_2, etc., and, similarly, spokes starting from S_B end at points B_1, B_2, etc. Components A_1S_A, A_2S_A, A_3S_A, etc., are still all complementary to each other. However, only components connected to the same central node, such as A_iS_A and A_jS_A, can be connected directly to make a composite good such as $A_iS_AA_j$. Components connected to different nodes, such as A_iS_A and B_jS_B are complementary but require component (gateway) S_AS_B to create $A_iS_AS_BB_j$, a demanded composite good. Thus we have two types of externalities. *Local network externalities* (in the same star) are immediate as before. *Long distance network externalities* require the gateway S_AS_B.

2.2 One-way Networks

Consider now *one-way networks*, such as ATMs, television (over-the-air and cable), electricity networks, retail dealer networks, the French Minitel, etc.[4] First, in such networks, a combination of any two components does not create a demanded composite good. Essentially there are *two types of components*, type A and type B, and the combination of a component of type A with a component (or components) of type B creates a demanded composite good. Thus, the setup of a one-way network looks like Figure 2, but only the "long distance" composite goods, such as $A_iS_AS_BB_j$, make sense. The "local" composite goods give no utility and therefore are not demanded.[5] Second, a one-way network lacks reciprocity, since goods $A_iS_AS_BB_j$ and $B_jS_BS_AA_i$ coincide. Third, customers are often not immediately identified with particular components or nodes.[6] Fourth, typically in one-way networks, a composite good is a closer substitute with a good with which it shares a component than with goods with which it doesn't. Fifth, such networks exhibit a variant of consumption economies of scope. Let there be originally m components of type A and n components of type B that can be combined in a 1:1 ratio so that there are mn composite goods. Then the addition of one more good of type A creates n new composite goods, and the addition of one more good of type B creates m new composite goods. As before, the externality is in the creation of new goods. When customers are identified with components, the one-way network exhibits (in the old terminology) "one-way long distance network externalities." Since this externality arises in the combination of components of *different types*, we call it an *inter-product network externality*. When customers are not identified with components, their benefit from the addition of new products is indirect; they are now able to find a variety that is closer to their ideal one, and, if new components are provided by new firms, competition may decrease prices.[7] Thus we can call *indirect network externalities* the economies of scope that are found in one-way networks.[8] Finally, the achievement of externalities in one-way networks again requires compatibility.

2.3 Vertically-related Markets

The most important common feature of both types of networks is the fact that composite goods are created from complementary components. There are large numbers of non-network industries, where final goods demanded by customers are composed of complementary components. In traditional terms these are called vertically-related industries.[9] A typical market with compatible components has m varieties of type A and n varieties of type B, where goods of type A are complementary to goods of type B. Composite goods are created by combining components of different types. See Figure 3. *These pairs of vertically-related markets are essentially identical (under compatibility) to a one-way network*, as pictured in Figure 2, with the understanding that goods $B_iS_BB_j$ and $A_iS_AA_j$ are of no value. Composite good $A_iS_AS_BB_j$ of Figure 2 appears as good A_iB_j in Figure 3. Accordingly, inter-product and indirect network externalities arise in vertically related markets in the same way as in one-way networks. In most vertically-related markets, consumers are not identified with particular varieties. Thus, we expect most network externalities to be of the indirect type. As in one-way networks, in most such markets a composite good is usually a closer substitute with a good with which it shares a component than with goods with which it doesn't.

2.4 Compatibility and Complementarity

In many situations, the complementarity between different types of goods is inevitable because it is a direct result of technical or other necessities. However, in many situations, complementarity is feasible but not inevitable. Firms have the option of making their products *not* complementary with other components. For example, a firm has the option of not offering its products through certain channels by *excluding* dealers. This is also easy to accomplish when the usefulness of the composite good depends on the *technical compatibility* between the components. Clearly, *compatibility makes complementarity feasible*. Thus, for products where technical compatibility defines potential complementarity, firms have the option of reducing or eliminating the complementarity of their products with other products by introducing different degrees of incompatibilities. Therefore *the decision to produce and sell a component that is incompatible with potentially complementary components is tantamount to exclusion.*

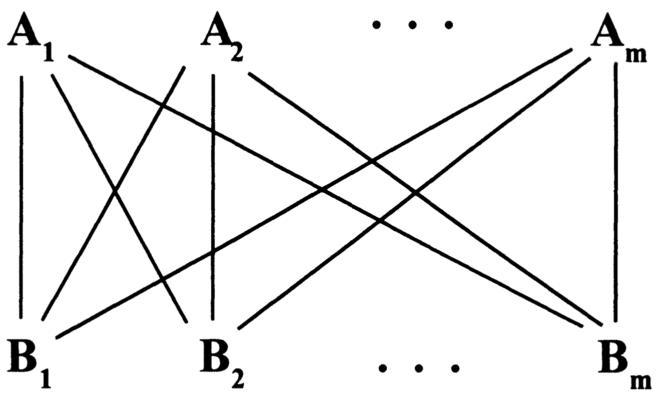

Figure 3

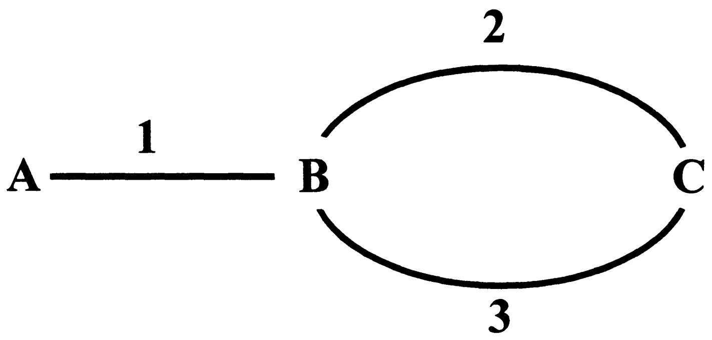

Figure 4

2.5 The Incentive for Compatibility in Various Ownership Structures

Consider an industry where products are produced with known technologies, there is costless coordination, price discrimination cannot be practiced, and there are no cost asymmetries created by any particular compatibility standard. Then, when a firm does not produce vertically related components, it has no incentive to create incompatibilities of its products with complementary components. When a firm is vertically integrated, the incentive for compatibility depends on the relative sizes of the demands for each combination of complementary components (composite goods). Compatibility expands demand but also decreases competition. Thus, when the demands for hybrid (across firms) composite goods is relatively large compared to the demand for the vertically integrated firm's own composite good, the integrated firm prefers compatibility.[10] When the demand for hybrids is small, an integrated firm prefers incompatibility. Thus, when the demand functions for the integrated firms are unequal and the demand for hybrids is closer to the smaller of the two integrated demands, the smaller integrated firm wants compatibility, and the larger integrated firm wants incompatibility.[11] In such cases of conflict, the presumption is that incompatibility wins, as it is very difficult for any firm to predict and fix all incompatibilities that a competitor may introduce. When price discrimination in the form of mixed bundling is available (selling the combination of the two components of the integrated firm at a lower price than the sum of their prices when sold as components of hybrids), the same general results hold with respect to the incentives for compatibility.[12]

2.6 Technical Standards Setting

If coordination to a particular standard is costly, firms may produce incompatible components, even when the demand rewards from compatibility are substantial. However, the incentive for compatibility could be enhanced if coordination to a particular standard puts a competitor at a cost disadvantage.[13] Further, a firm with proprietary information, which may be disclosed in the standard-setting process or in the regime of compatibility, has little incentive to participate in the process.[14]

It also has to be noted that compatibility does not just make combined products *feasible*, but *it also defines the quality and variety features of the composite good.* In some products, the quality of one of the components can determine the overall quality of the composite good. For example, a long distance phone call in the U.S. typically passes through parts of networks of three different firms, and the quality of the phone call may be determined by the lowest quality level among the three. With fragmented ownership, coordination to a specific quality level may be very difficult because of differences in costs. For example, in the network of Figure 2, let components A_iS_A be sold by firm A, components B_jS_B be sold by firm B, and S_AS_B be sold by firm G. Firms A and B may want to define qualities q_A and q_B that correspond to their respective demands for "local" phone calls, $A_iS_AA_j$ and $B_kS_BB_\ell$. These could easily be different, and further they may both differ from the optimal quality q_L for long distance phone calls $A_iS_AS_BB_\ell$. Thus, in networks of fragmented ownership there may be significant coordination problems on the specifics of the standard to be adopted.

2.7 Compatibility and Ownership Structure

Under compatibility, in a network setting or in vertically related markets, most mergers have both vertical and horizontal consequences. The simplest, almost trivial network, was considered by Cournot (1838). It consisted of one each of two types of complementary components, which could be depicted in Figure 3 with m = n = 1, or in Figure 1 with n = 2. Cournot showed that a vertical merger of two independent component monopolists leads to a reduction of price. This occurs because the monopolist can reap the full benefits of a price reduction. Economides and Salop (1992) show that Cournot's result generalizes to two vertically related markets with two varieties in each and complete compatibility, as shown in Figure 3 with m = n = 2. They show that bilateral vertical mergers which convert the market structure from "independent ownership" (where each component is produced by a different firm) to "parallel vertical integration," where goods A_i and B_i, i = 1, 2, are produced by the same firm, reduces prices. However, other mergers could change prices in either direction. A full merger from "independent ownership" to "joint ownership," where all products are produced by the same firm, can either increase or *decrease* prices. Similarly, a full merger, from "parallel vertical integration" to "joint ownership," again can increase or *decrease* prices. In both cases, the essence of this result comes from the fact that both mergers exhibit both horizontal and vertical elements, since each merger puts under the same ownership some substitutes and some complements. Thus, under non-pathological conditions, mergers to monopoly in one-way networks or vertically-related industries can be welfare increasing. A similar result can be shown for two-way networks. For example, if every spoke in the single-star network of Figure 1 was initially owned by a different firm, mergers between the independent firms could decrease prices and increase welfare.

Even in simple networks, the incentives for mergers among the various elements of the network cannot be easily categorized. Small changes in the configuration of the remaining network can change the direction of the incentive of a firm to merge two components of the network, as measured by the difference between the post merger profits and the sum of the profits of the individual pre-merger components.[15] Further, gateways can be of no value (and even be a liability) to the existing participants of a network, but be of value to a potential entrant. To see this, consider the network of Figure 3, with all A_iS_A links owned by firm A and all B_iS_B links owned by firm B, which also owns the gateway S_AS_B. How much should firm A pay to acquire the gateway? After acquisition, any price that firm A can charge for use of S_AS_B, it could have charged before on the links A_iS_A. Similarly, any price that firm B would charge for use of S_AS_B, it can already charge on links B_iS_B. Therefore, the strategic positions and the prices of the firms do not change. And, if S_AS_B carries a fixed cost, it is a liability to its owner. However, the gateway link can be sold at a positive price to a third party because the third party will now have some monopoly power on the network.[16]

In many industries, technology choice (implying choice of compatibility) is less flexible than the choice of the degree of vertical integration and thus of ownership structure. Often the degree of vertical integration of a firm can be easily changed through buying or selling units of production, while it is considerably more difficult to change the technology of production. Sometimes it may be feasible but undesirable to change the technology because of the large installed base of users of the old technology. Thus, often the decisions on technology and compatibility are less flexible than decisions on vertical integration. Therefore, competition can be modelled as a multi-stage game where choices on asset ownership follow choices on technology and compatibility, to be followed in a last stage by decisions on prices and quantities. Using this setting, Economides (1994a,b) shows that firms have strong incentives to vertically integrate under various degrees of incompatibility between the components, provided that the composite goods are not extremely close substitutes. Further, in a market with a symmetric demand system (so that the demands for each composite good are equal at equal prices), firms have strong incentives to choose full compatibility.

3. NETWORKS AND PUBLIC POLICY: ANTITRUST AND REGULATION

As the previous sections have indicated, the concepts of networks and compatibility can be understood in terms that have strong parallels with the more commonplace concepts of vertical relationships and complementarity. Accordingly, in our discussions of public policy—specifically, antitrust and regulation[17]—with respect to networks and compatibility we can draw on much of the existing literature that links vertical relationships and public policy. Our references to public policy will focus largely on the recent experience of the United States; but we believe that the lessons we draw have widespread applicability.

3.1 Mergers

Mergers between firms that are vertically related in network industries—either producers of different components in one-way network industries or operators of adjacent two-way networks—have a presumption of beneficial social consequences. All of the usual arguments for the benefits of vertical integration—improved coordination, elimination of double marginalization, elimination of inefficient substitution—apply. In an important respect, the improved coordination can be a paraphrase for improved compatibility. Further, as Carlton and Klamer (1983) point out, such vertical mergers may encourage greater innovation, since an innovator will experience fewer difficulties in reaping the gains of compatibility-linked innovations.

Examples of these types of beneficial mergers in network industries are easy to conjure: for one-way network industries, mergers of hardware and software companies or mergers of firms producing separate components; for two-way network industries, the merger of end-to-end rail networks, airlines, and telephone systems.

There are, however, well-known potential competitive dangers to vertical mergers—and, again, these potential pitfalls apply to network industries as well. Vertical mergers may be a means of perfecting a system of price discrimination, with its concomitant ambiguous consequences for social welfare. They may also be a means of quality discrimination, whereby a firm with market power distorts the quality levels provided to some customers so as to be able to charge higher prices to other customers;[18] here, the welfare consequences are likely to be negative. If the assumptions of constant returns to scale and easy entry are replaced by increasing returns to scale and/or difficult entry, vertical mergers may be a means of enhancing market power—e.g., by raising rivals' costs or enhancing strategic interactions.[19] Also, if a merger involves both vertical and competing horizontal elements (and if the horizontal feature cannot be easily cured by selling one of the two competing components to a rival or entrant), then difficult judgments concerning enhanced (vertical) efficiency versus enhanced (horizontal) market power may be necessary.

Again, it is easy to conjure examples of these problems for one-way and two-way network industries. For two-way network industries, Noll and Owen (1994) argue that AT&T, in its early days, benefitted by merging its long distance network with various local exchange systems and then refusing to connect independent local exchange companies to its network, thereby making those independents' services less attractive to customers (fewer long distance complementarities) and making it easier for AT&T to acquire those systems. In various end-to-end railroad mergers, the Interstate Commerce Commission (ICC) has often required that the merged entity provide through-rates and joint rates with rival railroads that provide competitive service along some local parts ("components") of the merged railroad's routes, so as to deter potential foreclosure; since the local routes themselves are likely to be separate markets (for local freight shipments) and to be subject to economies of scale, foreclosure of the longer shipments could indeed weaken these rival carriers and allow the merged entity to increase its market power in these local markets.[20] For one-way networks, the existence of economies of scale in one component could give a merged entity an advantage vis-a-vis its rivals.[21]

As an illustration of the problem that has worried the ICC, consider rail links between cities A, B, and C as in Figure 4. Link AB is owned by firm 1; firms 2 and 3 each own a BC link. Here there are five goods: AB, B2C, B3C, and their combinations AB2C and AB3C. The novel element of this structure is that some components (B2C and B3C) have utility as "stand-alone" goods, as well as components of composite goods AB2C and AB3C. Suppose that the ability of firm 3 to compete in the "short haul" BC market is affected by its volume of AB3C traffic (because of economies of scale or scope). In that case, a merger between firms 1 and 2 could have anticompetitive effects in the BC market if the merged firm is allowed to favor its B2C subsidiary through price discrimination. If the merged firm is not allowed to price discriminate, it may find it preferable to foreclose B3C rather than to supply AB to it at the same price it charges to its subsidiary B2C. The ICC rules (the through-rates and joint rates) were designed to try to prevent the foreclosure of or price discrimination against firm 3.

In the past two decades U.S. policy toward vertical mergers has been quite tolerant. The last Supreme Court decision forbidding a vertical merger was in 1972.[22] During the late 1970s and throughout the 1980s and the early 1990s the two federal antitrust agencies—the U.S. Department of Justice's Antitrust Division and the Federal Trade Commission—adopted a merger enforcement stance that virtually ignored vertical mergers. The DOJ's 1982 and 1984 *Merger Guidelines* devoted a comparatively small amount of attention (as compared with the DOJ's 1968 *Merger Guidelines*) to vertical mergers, and the jointly authored DOJ-FTC 1992 *Horizontal Merger Guidelines* did not mention vertical mergers at all! We are aware of only one instance in the last decade in which a merger with substantial vertical elements was halted by one of the federal enforcement agencies.[23]

In the two-way network regulatory area, during the 1970s and 1980s the Interstate Commerce Commission regularly approved end-to-end railroad mergers, the Civil Aeronautics Board (and, later, the U.S. Department of Transportation) approved end-to-end airline mergers (and even, arguably, approved some airline mergers with substantial horizontal elements[24]), and the Federal Communications Commission approved the merger of small, non-competing local telephone systems.

Is this tolerant public policy stance toward vertical mergers sensible? We believe that the answer is a cautious yes. The efficiency advantages to vertical integration do seem to be substantial in many instances. Nevertheless, there are the market power and social welfare dangers mentioned above, which inspire some caution. A case-by-case approach, with a moderately strong presumption toward approval, does seem sensible.

3.2 Joint Ventures

Where dominant firms are present in one-way or two-way network industries, these firms are likely *de facto* to set compatibility standards.[25] In instances where a dominant firm is absent but where compatibility can yield significant social gains, a coordinating mechanism may well be necessary.[26] Regulatory agencies, trade associations, and industry joint ventures can all serve as this mechanism. We will focus primarily on joint ventures. Agreements reached through industry trade associations can be considered as less formal joint ventures; and to the extent that regulatory agency decisions are influenced by the lobbying of the affected parties, this too might be considered to be a form of joint venture.

The beneficial effects of a joint venture to set standards and achieve compatibility are clearly strongest where the member firms are solely in vertical relationships with each other. In two-way network industries, for example, a joint venture among end-to-end railroads or among separate local-exchange telephone systems would be in this category; in one-way network industries, a joint venture among monopoly component manufactures would qualify. In such instances the joint venturers' primary interests are to achieve compatibility standards that maximize the efficiency with which their goods or services fit together to provide a composite good or service; anti-competitive consequences are unlikely.[27] Accordingly, such joint ventures should be strongly encouraged.

When the joint venturers are competitors (actual or potential) as well as in vertical relationships, the dangers are somewhat greater. This would be the case for railroads that may be mostly end-to-end but that also compete over some segments; for telephone companies that provide both (monopoly) local exchange service and (competitive) inter-city service; and for groups of competing components manufactures (some of which may be specialists and some of which may be vertically integrated). For this category of joint venture the incentives for efficient compatibility are still present and strong. But anticompetitive tendencies can also manifest themselves in a number of ways. First, the joint venture may simply provide the vehicle for blatant ("smoke-filled room") horizontal price-fixing. Second, the joint venture may be a vehicle for enhanced implicit coordination among the competitors. Third, the compatibility standards on which the joint venturers agree may favor some firms at the expense of others, and the latter could well be the competitive "mavericks" of an industry that has otherwise achieved some level of oligopolistic coordination.[28] Fourth, the joint venture might involve the actual production and pricing of one or more goods or services, with collusive pricing of those goods or services by the joint venture.

A somewhat realistic example of a one-way network—commercial banks and their automated teller machine (ATM) networks—can illustrate some of these concerns and complexities. For the purposes of this example we treat ATMs as having the sole function of dispensing cash to bank depositors.[29] It is useful to think of the bank's home office where the deposit is "located" as an upstream entity, equivalent to "the manufacturer" in many models; the ATMs (along with the tellers at the bank's home and branch locations) then become the points of "retail" distribution for dispensing the cash. *Ceteris Paribus*, the greater is the number of ATMs to which a depositor has access (i.e., that are compatible with his/her bank account), the greater is the convenience experienced by the depositor.[30]

Because of the economies of scale in the operation of an ATM, a bank will always be limited in the number and extent of its own ATMs (and hence will be limited in the convenience) that it can provide to its depositors. If the bank can provide its depositors with access to their deposits through other banks' ATMs (or through ATMs operated by non-bank entities) as well as through its own ATM[31] (i.e., if the other banks' ATMs become compatible with the first bank's deposits), the first bank's depositors will enjoy greater convenience. In return, the first bank is likely to have to allow its ATMs to be used by other banks' depositors to access their deposits (i.e., to make its ATMs compatible with their deposits). A joint venture among the cooperating banks could well be the best way to achieve the necessary compatibility (including the transmission of the necessary electronic information between the ATMs and the home banks, and the clearing of the net sums due each bank at suitable intervals).

At one extreme, one could imagine that the group of joint-venturing banks was strictly composed of one bank in each of a number of separate cities—i.e., a group of non-competing banks. In this case, the potential competitive harm would be virtually non-existent, but the convenience gained by the banks' depositors would also be small—limited to the occasions when the depositors were traveling in another city where one of the joint venture banks was located.

Suppose instead that all of the joint venturing banks were competitors located in the same city. In this case the convenience to depositors would be much greater, but the potential threats to competition would also be greater.[32] The joint venture might serve as a communications vehicle for explicit price fixing of a broad range of banking services among the banks. It might serve as a vehicle for improving their implicit oligopolistic coordination. The joint venturing banks might use it as vehicle to discipline a "maverick" bank in their city—either by excluding it entirely or by adopting an interchange technology that is more costly for that bank than for the others. Finally, if the joint venturers decide that they want to charge fees specifically for ATM withdrawals, the joint venture itself could become the collusive vehicle for the setting of those fees (rather than letting each bank decide individually on its ATM withdrawal fees).

This last pricing issue is quite complicated and warrants further discussion. An "upstream" bank may well have a legitimate concern as to how a "downstream" ATM sets prices for the withdrawal services by that bank's depositors. (This concept, of course, provides the basic rationale for the benevolent view of resale price maintenance.) Within an ATM joint venture, can each bank separately negotiate the necessary understandings with the other members of the joint venture? Would the prices faced by consumers at various ATMs thereby become too variable and too confusing?[33] Are the efficiency interests of the joint venture best served by having the joint venture collectively set the prices at some uniform level? But won't these prices approximate the joint monopoly level (if the joint venture has market power)? We see no easy answers to these questions.[34]

Further, even if each bank and ATM remain free to set its own prices, a joint venture with market power could levy a tax on each transaction; so long as the proceeds of the tax are not returned to the joint venture members in proportion to their transactions, the tax could be the vehicle for the joint venture to reap (and distribute) monopoly profits.[35]

In sum, the questions surrounding the pricing (if any) of the joint venture's product(s) are difficult ones that should inspire caution and concern both about joint venture efficiencies and about the possible exercise of market power.

Of course, the ability of the joint venturers to succeed in any anti-competitive efforts would be dependent on their ability to exercise market power in their market. If the competing banks were unlikely collectively to exercise market power, then the compatibility joint venture would be unlikely to have anti-competitive effects. In this respect we believe that the DOJ-FTC *Horizontal Merger Guidelines* provide a useful framework for analyzing the relevant market and the possibilities of non-competitive behavior by the joint venturers.

Accordingly, though we believe that great benefits can be achieved from such compatibility-oriented joint ventures (again, we include trade association efforts in this category) and we believe that virtually all such joint ventures should be allowed to proceed, we also believe that some of them may warrant public policy scrutiny to deter their potential anti-competitive effects. Where the compatibility joint venturers are solely non-competitors, there are few dangers, and little or no public policy scrutiny is required. Where the compatibility joint venturers are competitors, however, the dangers are greater, and more antitrust scrutiny is warranted. The *Horizontal Merger Guidelines* can be used as a framework for ascertaining potential competitive harm. If the compatibility joint venture qualifies for a *Guidelines* safe harbor (e.g., because of a low combined market share of its members), again no further scrutiny is necessary. If the compatibility joint venture's market indicia place it in the "potential danger" zone, then the joint venturers should be aware that as a matter of policy their pricing and competitive behavior will be subject to closer public policy scrutiny: e.g., the antitrust agencies should give more attention to the complaints of excluded rivals[36] and of disadvantaged members and to the pricing practices (if any) of these compatibility joint ventures.

3.3 Vertical Restrictions

Decisions by firms to impose compatibility against some vertically related firms (but not against others or against the firm's own vertically integrated subsidiary) have close analogies with traditional and familiar vertical restraints and restrictions. Indeed, most of the traditional vertical restraints could be re-interpreted as incompatibility by fiat, rather than incompatibility due to technology (or to technological decision), but the economic effects in either case are likely to be quite similar. Our discussion applies to both two-way and one-way networks.

In essence, a decision by a firm to restrict compatibility—and thereby limiting the ability of some other "upstream" or "downstream" firms to interconnect with the original firm or to have their products (components) be combined with those of the original firm—can be seen as an act of tying (from the perspective of the customer) or of exclusive dealing or refusal to deal[37] (from the perspective of the rival firms).[38] As one-way network examples, suppose that a camera firm develops a new camera that is compatible only with film that is produced by its own subsidiary[39] (or by one or a few cooperating firms), or a computer manufacturer develops a new hardware unit that is compatible only with software (or cartridges) developed by its own subsidiary[40] (or by one or a few cooperating firms). This can be viewed as a tie (by consumers) or as exclusive dealing (by rival film or software firms). As a two-way network example, suppose that a vertically integrated telephone company (i.e., one that provides both local exchange and inter-city service) adopts a technology that makes it more difficult or impossible for a rival long-distance carrier to interconnect. Again, this can be viewed as a tie (by the customers) or as a refusal to deal (by the rival long-distance carrier).[41]

As we noted above in our discussion of vertical mergers, there are benign and beneficial (efficiency) reasons for firms to want to attain these forms of vertical integration. But there can also be anticompetitive motives that will increase inefficiency. Accordingly, a rule-of-reason approach to these vertical restraints—whether considered in the traditional context or in our network and compatibility context—seems sensible. We strongly support the notions that a showing of an absence of actual or potential market power should be an automatic safe harbor for these practices and also that the familiar phrase of antitrust policy—antitrust should protect the competitive process, and not individual competitors—warrants continual re-emphasis.

4. CONCLUSION

In this chapter we have explored and dissected the concepts of networks and compatibility and applied our analysis to antitrust policy. In important ways, compatibility (and the networks that rely on it) can be understood through the lens of complementarity and vertical relationships. We believe, however, that there are distinct and interesting differences between two-way and one-way networks.

Turning to antitrust policy, we specifically examine vertical mergers, compatibility-oriented joint ventures, and vertical restraints. Our linking of compatibility with complementarity provides a framework for analyzing these antitrust issues and showing that, as with most vertical relationships (through merger, integration, or contract), there are strong arguments for the beneficial nature of most compatibility and network arrangements but that, under some circumstances, anti-competitive consequences can arise. Our policy prescription can be summarized as one of general tolerance and encouragement of these arrangements but with enforcement powers available to curb anti-competitive practices and arrangements.

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NOTES

1. For recent summaries of some network issues, see Katz and Shapiro (1994), Besen and Farrell (1994), and Liebowitz and Margolis (1994).

2. We assume that there is adequate capacity at S so that an additional customer does not create significant congestion costs. Even with moderate congestion costs or moderate costs of expanding capacity, the basic externality concept would still apply.

3. These features are not changed if there exists some component(s) of the network that is a part of all demanded goods as when the central switch S of the previous example is considered as a component, and each composite good ASB is composed of three components: AS, SB, and S.

4. Minitel could be classified as either a one-way or a two-way network because it plays both functions. When users access a database, Minitel acts as a one-way network; when users contact each other, it acts as a two-way network.

5. For example, if A_is are ATM machines and B_js are banks, the combination of two ATMs by themselves (but not linked to a bank), $A_iS_AA_j$, gives no utility.

6. Electricity networks are an exception, since customers and nodes coincide.

7. Farrell and Saloner (1985) describe this as a "market-mediated effect."

8. Liebowitz and Margolis (1994) discuss whether these indirect network externalities are likely to be pecuniary or technological in nature.

9. The industries include, for example, hardware-software combinations and upstream-downstream relationships. It is worth noting that a number of authors who have written about "network externalities" identify these externalities with vertically-related industries. See Farrell and Saloner (1986), Katz and Shapiro (1986, 1992), Church and Gandal (1992), and Economides and Salop (1992).

10. Matutes and Regibeau (1988, 1992), Economides (1989).

11. Economides (1988, 1991).

12. Matutes and Regibeau (1992), Economides (1994a).

13. For an analysis of the strategic effects of raising the costs of competitors see Salop, Scheffman, and Schwartz (1984).

14. Apple in the 1980s and early 1990s argued that its proprietary design of the operating system of the Macintosh would be compromised if it disclosed sufficient information to

establish compatibility standards. Baumol (1983) discusses an example of a railroad that would not interconnect so as not to disclose the names of its customers.

15. See Economides and Woroch (1992).

16. This argument is adapted from Economides and Woroch (1992).

17. By regulation we specifically mean the forms of *economic* regulation that have frequently served as a substitute for antitrust in a number of industries (e.g., transportation, telecommunications).

18. See White (1977), Mussa and Rosen (1978), Donnenfeld and White (1988, 1990), and Bradburd and Srinagesh (1989).

19. See, for example, Salinger (1988), Ordover, Saloner, and Salop (1990), and Whinston (1990).

20. For various discussions of these railroad problems, see Carlton and Klamer (1983), Baumol (1983), Grimm and Harris (1983), and McFarland (1985).

21. Though the specific case involves internal vertical integration rather than vertical merger, the relationships between airlines and their computer reservations systems might well fall into this category; for a discussion, see Guerin-Calvert (1994).

22. *U.S.* v. *Ford Motor Company*, 405 U.S. 562 (1972).

23. This involved the merger of the Showtime and Movie Channel cable services. The initial proposal for this merger also involved (vertical) ownership by three of the six major moving picture distributors. This version of the proposed merger was challenged by the DOJ. For more details, see White (1985).

24. At least, the DOJ so argued in its comments to the U.S. Department of Transportation, opposing the merger of TWA and Ozark and of Northwest and Republic.

25. This initial conjecture by Braunstein and White (1985) was later demonstrated in formal models by Farrell and Saloner (1986) and Katz and Shapiro (1986).

26. Though there are models (e.g., Economides, 1988, 1989; and Matutes and Regibeau 1988, 1992) that show that non-cooperative oligopolists will choose compatibility as their profit-maximizing choices, these models assume a frictionless world. In a world with frictions, a coordinating mechanism may be necessary.

27. One possible anti-competitive consequence might be as follows: If all of the non-competing firms were to recognize some new firm as a potential threat to any (or all) of them, they might adopt a compatibility standard that was more costly for that new firm.

28. Arguably, it is this sort of "maverick" situation that was the Supreme Court's concern in *Radiant Burners, Inc.* v. *Peoples Gas Light & Coke Co.*, 364 U.S. 656 (1961) and *American Society of Mechanical Engineers, Inc.* v. *Hydrolevel Corp.*, 456 U.S. 556 (1982)

29. Real-world ATMs also accept deposits and offer other services. The acceptance of deposits might make an ATM network appear to be a two-way network: Depositors can receive cash from banks and also send cash to banks. But such a system would lack the other crucial feature of a two-way network: that *any* two components can be combined to form a meaningful composite good. Accordingly, even this more realistic ATM system would be best considered as a one-way network (i.e., it is more akin to a manufacturer-retailer or hardware-software system than to a telephone or railroad system).

30. This is akin to the idea that the greater and more widespread are the number of retail outlets at which a consumer can buy his/her favorite brand of soft drinks, the greater is the convenience to the consumer.

31. Again, a useful analogy would be a group of manufacturers that are also vertically integrated into retailing, and each would like to distribute its products through the others' retail establishments as well as through its own.

32. We can think of at least two real-world examples of such instances of vertically integrated competitors' distributing their products through each others' retail outlets: Prior to the 1950s, the major movie distributors ("studios") were also exhibitors (i.e., they also owned movie houses), and each distributor's exhibitors also showed the films of other distributors. A major antitrust case in the 1940s resulted in the vertical divorce of movie distribution from exhibition; see *U.S.* v. *Paramount Pictures, et al.*, 334 U.S. 131 (1948). As a second example, airlines frequently reserve and sell tickets for travel on rival airlines through their own computer reservations systems.

33. We note, however, that the Coca-Cola Company does not appear to be unduly concerned that consumers are likely to face varying prices for its cans of cola across vending machine outlets, convenience stores, supermarkets, and discount warehouses. Is a bank more likely to be concerned about the uniformity of the prices for deposit withdrawals at ATMs? Why?

34. Further discussion of these issues with respect specifically to ATMs, with differing views, can be found in Gilbert (1991) and Salop (1990, 1991); for a discussion with respect to credit card transaction networks, which involve similar issues, see Baxter (1983).

35. This argument can be found in Lewis and Reynolds (1979).

36. Arguably, the complaint by Sears that a Utah bank subsidiary was prevented by Visa (a joint venture of thousands of banks) from being able to issue Visa cards might fall into this category. In response, Visa has claimed that Sears, as owner of a rival general purpose

credit card (Discover) might gain an unfair competitive advantage by joining Visa and learning about its technological and competitive strategies.

37. One variant of a refusal to deal is the "essential facilities" doctrine. For a discussion, see Reiffen and Kleit (1990), Werden (1988), and Ratner (1988).

38. Though we present these practices in terms of a single firm's decisions, they could also apply to the practices of a compatibility-oriented joint venture, discussed in the text above.

39. These kinds of allegations were raised in *Berkey Photo* v. *Eastman Kodak Co.*, 603 F. 2d. 263.

40. This type of claim was raised in the recent lawsuit by Atari Corp. against Nintendo of America Inc.

41. The same result can be achieved, of course, if the integrated company charges an excessively high price to the non-integrated company; in essence, a "price squeeze" can be a *de facto* substitute for a refusal to deal or foreclosure.