INDEPENDENT SERVICE ORGANIZATIONS AND ECONOMIC EFFICIENCY

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I. INTRODUCTION

Many manufacturers of capital equipment provide maintenance service to their equipment users. Sometimes equipment and service are sold separately and at other times they are bundled (e.g., through leases and rental agreements). Numerous recent antitrust cases revolve around allegedly anticompetitive practices used by some manufacturers to deter independent service organizations (ISOs) from servicing the manufacturer’s equipment. Indeed the volume of cases brought by ISOs in the past decade exceeds litigation in more conventional antitrust areas like antimerger disputes and cases under the Robinson Patman Act.¹ The controversial practices in these cases include tying sales of equipment and service, tying sales of service and other “aftermarket” products, refusals to sell replacement parts to ISOs, and refusals to license operating or diagnostic software to ISOs.

The pivotal issue in these cases is whether practices that deter ISOs injure competition in the service aftermarket.² Manufacturers claim their customers shop for equipment and service simultaneously. That is, customers choose a proprietary “system” comprised of equipment, service and other components instead of merely choosing a brand of equipment (Shapiro and Teece). This line of reasoning holds that (interbrand) competition for systems disciplines the pricing of every component in the system and, therefore, is sufficient to protect equipment users’

¹ See Appendix A for a sample of recent cases.

² The manufacturer practices in question can be analyzed in either of two frameworks: one where there are antitrust-relevant service aftermarkets as well as related equipment markets, and another where equipment and service are components in a single “systems” market (Shapiro and Teece). In this paper, we sidestep which framework is best. We utilize the separate relevant markets framework because it is the one adopted by most of the literature on the cases.
welfare. If one manufacturer’s equipment is priced above rivals’, the high-priced equipment manufacturer must supply service at a lower price than its rivals to remain competitive on a “total cost of ownership” (TCO) basis.\(^3\) Brand-specific (intrabrand) competition in the service aftermarket is not necessary to maximize equipment users’ welfare. Because systems competition is sufficient, manufacturer practices that deter ISOs or discourage intrabrand service competition cannot injure competition.

ISOs claim that systems competition does not adequately discipline manufacturers’ service pricing. Once customers acquire a piece of durable equipment, they cannot replace it with another brand without incurring switching costs. Thus, it is argued, such customers become “locked in” to the manufacturer for maintenance service and are left vulnerable to opportunistic service pricing throughout the useful life of the equipment (Salop). The only protection customers enjoy from exploitation by manufacturers in the service aftermarket is the protection afforded by ISOs.

In the much cited \textit{Kodak} decision,\(^4\) the Supreme Court rejected the notion that interbrand competition in systems (or equipment) \textit{always} is sufficient to prevent the exercise of monopoly power in the service aftermarket. The Court was influenced by recent economic research that highlights theoretical opportunities for equipment manufacturers to exploit their locked in

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\(^3\) TCO equals the initial cost of equipment plus the cost of service while the equipment is in use minus the salvage or trade in value of equipment. Sometimes this concept is called the “total cost of operation” or “full-life-cycle cost.”

customers. These theoretical opportunities stem from information costs faced by customers and incomplete contracts between manufacturers and their customers.\(^5\)

Carl Shapiro recounted the “available theories of antitrust injury” (p. 485) that apply to these circumstances. These theories include (i) **incomplete information**, where customers who are poorly informed about the TCO of competing brands of equipment are exploited by manufacturers once they become locked in; (ii) **opportunistic pricing**, where manufacturers break trust with their locked-in customers (and sacrifice their reputations) by implementing unanticipated increases in service pricing; (iii) **inability to commit**, where higher-than-competitive service pricing, and lower-than-competitive equipment pricing, arise because manufacturers cannot provide contractual assurances about future service prices (Borenstein, MacKie-Mason and Netz, 1995 and 2000); and (iv) better opportunities for **price discrimination** afforded by the absence of independent maintenance providers.

The **price discrimination** theory of lock-in exploitation differs from the previous three in that price discrimination often improves rather than impairs market performance. Zhiqi Chen and Thomas W. Ross (1993) and Benjamin Klein have argued that, in practice, the price

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\(^5\) In some post-**Kodak** antitrust cases, a key consideration has been whether a manufacturer has changed its service policy before or after locking in its customers. In these cases, information costs themselves do not establish illegal market power. In other cases, a key issue is whether or not the cost of switching from one product to another is significant. **Kodak** also has been used by plaintiffs attempting to undo established franchise arrangements. Some commentators believe that **Kodak**, by introducing into antitrust enforcement the concepts of information and switching costs, has raised the bar for defendants seeking to secure summary judgment in antitrust cases. See Areeda, Elhauge and Hovenkamp, pp. 33-38, and Areeda and Hovenkamp, pp. 40, 131-149 and 480-483.
discrimination facilitated by the absence of ISOs from service aftermarkets is likely to have beneficial welfare consequences.

The *incomplete information* theory of lock-in exploitation does not apply if buyers are aware, *ex ante*, of future service costs and make decisions about the acquisition of equipment on a TCO basis. Unless prospective buyers are myopic, self-interest compels them to take the future cost of service into account when choosing equipment. The *opportunistic pricing* theory does not apply in so far as buyers can rely on a manufacturer’s “strong reputation for fair dealing” (Klein, 1996, p. 148) or can obtain *ex ante* contractual assurances from manufacturers concerning future service pricing.

The *inability to commit* theory of lock-in exploitation is undercut if customers can get service price commitments from manufacturers at the time equipment is acquired. Some equipment manufacturers are able to give users contractual assurances with respect to future service pricing by means of warranties, buy-back guarantees, and multi-period service contracts.

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6 Lock-in exploitation may not occur even if a small fraction of users are myopic. The number of myopic users may be insufficient for any manufacturer to specialize in selling and servicing their equipment (Salop and Stiglitz). Or manufacturers with a broader customer base may not be able to single them out for discriminatory pricing. The most plausible class of vulnerable customers are those whose purchasing procedures departmentalize equipment acquisition and service contracting so thoroughly that decision makers who buy equipment are indifferent to the service cost implications of their acquisition decisions.

7 An equipment manufacturer with a long planning horizon would be reluctant to gouge its current customer base since today’s locked-in users are tomorrow’s new equipment customers. Indeed, in cases where users employ many pieces of equipment with overlapping lives, today’s locked-in users also are today’s new equipment customers. The *opportunistic pricing* theory is most plausible where demand for a manufacturer’s equipment is in drastic decline, or where a manufacturer makes a calculated retreat from the market, so that preserving a reputation for fidelity is of little value.
For example, users of Kodak or Xerox high-volume photocopiers can purchase maintenance agreements that run up to five years. Further, many equipment users prefer to lease or rent expensive capital equipment rather than purchase it. Manufacturers generally offer extended service contracts as part of the lease or rental terms. These contracts offer the option of a guaranteed service price for the duration of the lease.\textsuperscript{8}

In markets where the first three “available theories” do not apply, no manufacturer can exploit its existing customer base. Hence, no antitrust aftermarket problem can arise in these markets. The presence of ISOs and intrabrand service competition are not required to keep manufacturers from creating antitrust injury.

Without lock-in exploitation opportunities, Shapiro and Borenstein et al., assume that deterring ISOs would be harmless. In this paper we argue that, absent lock-in exploitation, ISOs actually \textit{injure} competition by distorting equipment and service prices. Consequently, unless intrabrand service competition is needed to prevent lock-in exploitation, practices that deter ISOs improve market performance.

To summarize our argument: while “equipment” and “service” are components in a system for producing output, these components can be used in variable proportions to produce that output. Equipment and service are substitutes because the service intensiveness of equipment increases with use, meaning a customer can replace equipment frequently and conserve on service expense or extend the useful life of equipment by purchasing more service.

\textsuperscript{8} It is the widespread \textit{availability} of multi-period contracts, extended maintenance agreements, etc. to prospective customers more than the fraction of such customers who actually choose them that subverts this theory of lock-in exploitation.
When manufacturers engage in systems competition, equipment and service prices are Ramsey-optimal, or welfare maximizing. Ramsey-optimal prices spread manufacturers’ (often substantial) fixed R&D and production set-up costs over the sale of both equipment and service. While these prices exceed marginal costs, they maximize welfare by inducing customers to utilize components efficiently.

Intrabrand service competition reduces the price of service to the break-even level for ISOs. This price is below the Ramsey-optimal price level for service because ISOs do not engineer or manufacture equipment and do not incur the fixed R&D and production set-up costs that manufacturers incur. As the price of service falls, manufacturers must raise the price of equipment above the Ramsey-optimal level in order to recover their fixed costs. Accordingly, if ISOs compete with manufacturers in the service aftermarket alone, component prices are distorted and the welfare of equipment users is diminished.

The pricing distortion introduced in these circumstances by intrabrand service competition induces customers to utilize equipment inefficiently (Vernon and Graham) and raises customers’ TCO. Manufacturer practices that foreclose ISOs from service aftermarkets preserve the benefits of systems competition and actually improve market performance. This is because systems competition achieves a more efficient outcome than a regime where competition sets prices for the components separately.

Chen and Ross (1998) make a related point in the specific case of manufacturers who refuse to sell proprietary replacement parts to ISOs for use in servicing their equipment. They show that a judicial order to supply replacement parts can injure market performance by inducing ISOs to supply inefficient service. This is because manufacturers, forced to sell replacement
parts to ISOs with whom they compete in the service aftermarket, would do so at prices greater than marginal cost. These prices would provoke ISOs to use replacement parts too sparingly when servicing equipment. While this “inefficient service” distortion bears upon how intensively proprietary replacement parts are used in the provision of service, the distortion we identify goes to the substitutability of service (with or without replacement parts) for equipment. This distortion, unlike the “inefficient service” distortion, would persist even if ISOs had access to nonproprietary replacement parts.

Of course, there are efficiency-based reasons why manufacturers might want to deter ISOs other than enabling price discrimination and quashing input distortions. There may be economies of scope in manufacturing and servicing equipment (e.g., cumulative maintenance experience provides valuable feedback for improving equipment design) that cannot be exploited fully by manufacturers who must compete with ISOs in the service aftermarket. ISOs may create a moral hazard for manufacturers insofar as they affect equipment users’ perception of equipment quality (Schwartz and Werden). Also, higher-than-marginal-cost prices for service may be an efficient way to recover equipment warranty costs (Chen and Ross, 1999). Finally, ISOs may free ride off manufacturers' training of service personnel, uncompensated use of technical documentation, and pirating of software.

II. ISOs IMPAIR EFFICIENT EQUIPMENT UTILIZATION

Consider a specific class of maintenance-intensive capital equipment like high-resolution medical imaging equipment or high-speed printing systems. Because of wear and tear, the flow
of output\(^9\) produced by the equipment depends on two factors. The first is how much service -- routine maintenance, replacing worn parts, etc. -- the equipment receives while it is in use. The second factor is how much output the equipment is called upon to produce before it is retired -- how frequently old equipment is replaced with new. In steady state, a given flow of services can be achieved by replacing machines more often, and maintaining them less, or retaining machines longer and servicing them more. These options imply that equipment and service are variable proportion inputs in the production of a flow of output from the equipment.

Output production involves variable proportions in this context if, in steady state, the amount of service required per unit of output is an increasing function of cumulative output produced by a piece of equipment. This connection between the deterioration of capital and the cost of maintenance is a nearly ubiquitous characteristic of capital equipment (Schmalensee, Feldstein and Rothschild, and, more recently, Nelson and Caputo). In this paper, we stress intrabrand substitutability of service and equipment.\(^{10}\)

Let production possibilities for the flow of user \(j\)’s output \(z_j\) be expressed as \(z_j = f(x_j, y_j)\), for any user \(j\) where \(x_j\) is the user’s rate of new equipment acquisition and \(y_j\) is the same user’s rate of brand-specific equipment service in steady state. (To simplify, we dispense referring to rates and flows, and call \(x\) “equipment” and \(y\) “service.”) Assume that all users have the same

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\(^9\) The flow of output incorporates both qualitative and quantitative aspects of the goods or services produced. For example, the flow of output produced by a medical imaging device depends on the image resolution as well as the number of images produced.

\(^{10}\) Even with intrabrand substitutability of service and equipment, interbrand systems competition still makes brand-specific service and equipment “gross complements” if the output effect of a change in the price of a component exceeds this substitution effect.
quasi-concave production function $f(\cdot)$ that is homogeneous of degree one. The output produced by competing manufacturers’ brands of equipment is homogeneous, but equipment and service are non-interchangeable inputs in the sense that every manufacturers’ equipment requires brand-specific service (perhaps but not necessarily involving brand-specific replacement parts or software). It is immaterial whether users consume output directly or use it as an intermediate product.

Aggregating over all users $j$, the (inverse) demand for $z$ is $p(z)$, where $p'(z)<0$. Assume that equipment users are completely informed about the service requirements and costs they face when they acquire equipment and that equipment manufacturers make binding service pricing commitments at the time users acquire equipment.

Each equipment manufacturer $k=1, 2, \ldots n$ produces $x_k$ units of equipment and incurs costs of $F + cx_k$, where fixed costs $F$ include research and development costs as well as production set up costs. Each manufacturer provides brand-specific service in the amount $y_k$ on its equipment. Service is provided with constant returns to scale and its cost is normalized to one for all of the brands. There are no economies of scope in the manufacture of equipment and the provision of service.

Let units of $x$, $y$, and $z$ be normalized such that $f(1, 1) = 1$, where $(1, 1)$ is users’ cost-minimizing input combination for producing $z_j=1$. As $f(\cdot)$ is homogeneous of degree one, the cost-minimizing ratio of components is the same for every user regardless of $z_j$. Thus, if input utilization were efficient, every unit of $z$ would be produced by using one unit each of $x$ and $y$. The marginal cost of a unit of $z$ with efficient input utilization would be $c+1$.  

The equipment manufacturing industry is an oligopoly with $n$ firms because of scale economies. Each equipment manufacturer offers its customers service on the machines it manufactures. Whether these integrated firms co-exist with ISOs\textsuperscript{11} depends on the structure of the service industry. In what follows, two service industry configurations are explored.

We begin with an “integrated regime” in which manufacturers are the exclusive providers of brand-specific service for their machines. In this regime, competition among integrated manufacturers occurs on a systems basis. There are no ISOs and there is no intrabrand service competition.

Next we ask what happens when integrated firms must compete with ISOs in their service aftermarkets. Suppose there are ISOs who offer maintenance service for each brand of equipment. (It does not matter whether ISOs service more than one brand of equipment.) In this “separated regime,” manufacturers are mere competitors in their brand-specific service aftermarkets. Interbrand competition among manufacturers retreats to the separated equipment market.

THE INTEGRATED REGIME

In an integrated regime, manufacturers compete with each other by offering users branded systems consisting of equipment and service. Each user $j$ purchases equipment and service from a firm whose component prices minimize the cost of producing $z_j$ when $x_j$ and $y_j$ are combined in

\textsuperscript{11} It is immaterial whether an ISO for brand 1 equipment is also a manufacturer of brand 2 equipment (as is illustrated by Kodak’s offering service for its rival Xerox’s high-speed photocopiers) since there are no economies of scope in producing $x$ and $y$. 

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cost-minimizing proportions, subject to those prices. In other words, users are TCO oriented in their choice among suppliers. To maximize its profit, each manufacturer sells components on terms that induce customers to combine equipment and service efficiently. Selling on other terms would be less profitable. Let \( r \) and \( t \) be the prices for equipment and service respectively. If a manufacturer were to set its component prices such that \( r/t < c \), then its customer \( j \) would minimize the cost of producing \( z_j \) by combining equipment and service such that \( x_j/y_j = 1 \).

However, the manufacturer could induce efficient production downstream and earn at least as much profit while reducing customer \( j \)'s production costs if it adjusted its prices to where \( r/t = c \).

Thus, in the integrated-regime equilibrium, profit maximization causes these prices to take on values \( r_I \) and \( t_I \) such that \( r_I/t_I = c \).

As every user buys equipment and service on these terms, and as production has constant returns to scale, every user combines equipment and service in the same proportion. For this reason, there is no loss of generality in supposing that the integrated firms themselves produce output, combining components so that marginal costs are \( c+1 \), and then sell the output to users at the price \( p \).

The equilibrium level of this price \( p_I \) depends on the number of firms in the integrated regime and on oligopolistic interactions among those firms. It is unnecessary to specify precisely what these interactions are. It is enough simply to impose some restrictions on the resulting equilibrium. First, assume that all firms have complete information and that the oligopolistic equilibrium is symmetric. Suppose the equilibrium output of each firm, when there are \( n \) firms, is given by the differentiable function \( g(n) \), where

\[ -g(n)/n < g'(n) < 0 \]
These inequalities imply that as the number of firms increases, the output of each firm $g(n)$ decreases even though total output $ng(n)$ increases. Finally, assume that

$$\lim_{n \to \infty} ng(n)$$

is finite, and

$$\lim_{n \to \infty} p(ng(n)) \geq c + 1$$

These inequalities imply that the aggregate supply of output is bounded above and that the equilibrium price of output is never below marginal cost no matter how many firms there are. This collection of assumptions about oligopolistic interactions encompasses Cournot-Nash interactions as well as interactions that are more and less competitive than the Cournot-Nash benchmark.

The number of firms $n_i$ in the integrated regime is endogenous and is determined by a free-entry condition. Neglecting the integer constraint, $n_i$ is given uniquely by

$$\left[ p(n g(n_i)) - c - 1 \right] g(n_i) = F.$$  

Free entry means the $n_i$ integrated firms produce total output of $z_i = n g(n_i)$, and earn zero economic profit. The (effective) price customers pay for units of output is

$$p_i = p(z_i) = c + 1 + F/g(n_i).$$  (1)

This price exceeds the marginal cost of $z$ by only the amount required to cover firms’ fixed costs for equipment.

In reality, of course, manufacturers do not actually produce and sell units of $z$ to their customers. Instead, they sell their customers units of $x$ and $y$ at the separate prices $r_i$ and $t_i$.

From the analysis above, we see that equilibrium values of these prices must satisfy two conditions:
\[ r_i + t_i = p_i, \text{ and} \]
\[ r_i / t_i = c \quad (2a, b) \]

The prices of \( x \) and \( y \) (i) must add to \( p \), since firms’ profits are zero and every customer \( j \) has \( x_j = y_j = z_j \), and (ii) must be in the ratio \( c / l \). Conditions (2a,b) establish that in the integrated-regime equilibrium, system components are sold at Ramsey-optimal prices — prices that maximize customers’ welfare subject to manufacturers covering their costs. Combining equations (1) and (2a,b), these prices are:

\[ r_i = c \left[ 1 + \frac{F}{g(n)(c+1)} \right] \quad (3a) \]
\[ t_i = \left[ 1 + \frac{F}{g(n)(c+1)} \right] \quad (3b) \]

THE SEPARATED REGIME

In the integrated regime, entry is free but all equipment service is performed by manufacturers. Next suppose that free entry conditions prevail in service aftermarkets and manufacturers compete with ISOs to supply brand-specific service on their own brands of equipment. How does this regime change affect market performance? In particular, do equipment users pay more or less for \( z \) as a consequence of the change?

With ISOs in the picture, the terms of sale of equipment and service are no longer “as though” integrated firms produce output efficiently and sell to users at break-even prices. In this regime, interactions among the manufacturers determine only \( r \), the equilibrium price of equipment. Service competition from ISOs drives \( t \), the price of service to unity (marginal cost).
no matter what the price of equipment is. Intrabrand service competition causes ISOs and manufacturers alike to earn zero profits repairing and maintaining customers’ machines.

The equilibrium level of the price \( r \) depends on the number of firms in the separated regime and on oligopolistic interactions among those firms. In keeping with the previous analysis, suppose the equilibrium level of \( x \)-production of each firm, when there are \( n \) firms, is given by the differentiable function \( h(n) \), where

\[
-h(n)/n < h'(n) < 0
\]

\[
\lim_{n \to \infty} nh(n) \text{ is finite, and}
\]

\[
\lim_{n \to \infty} p(nh(n)) \geq c
\]

Also in keeping with previous analysis, the number of firms \( n_S \) in the separated regime is endogenous and is determined by a free-entry condition. Users’ aggregate (inverse) demand for equipment, \( r(x, t) \), is derived from users’ demand for output \( p(z) \), the price of service \( t \), and the production function \( f(x, y) \). Previous assumptions about \( p(z) \) and \( f(x, y) \) imply that \( \partial r/\partial x < 0 \).

Neglecting the integer constraint, the free-entry number \( n_S \) of manufacturers in the separated regime is given uniquely by

\[
[r(n_S h(n_S), 1) - c]h(n_S) = F.
\]

Thus the separated regime has \( n_S \) manufacturers who produce \( x_S = n_S h(n_S) \) units of equipment and earn zero economic profit. Users pay

\[
r_S = r(x_S, 1) = c + F/h(n_S)
\]  

\[
t_s = 1
\]
for equipment and service in this regime. The equipment price $r_s$ exceeds the marginal cost $c$ of a unit of equipment by just enough to cover fixed R&D and production set-up costs.

The prices of equipment and service in the separated regime are not Ramsey-optimal. Combining equations (4a, b) yields

$$
r_s/t_s = c + F/h(n_s) > c,
$$

which compared to equation (2b) implies that

$$
r_s/t_s > r_l/t_l.
$$

This inequality indicates that equipment is relatively more expensive, and service relatively less expensive, in the separated regime than in the integrated regime. This induces users to choose a different combination of equipment and service than in the integrated regime. The cost-minimizing combination of equipment and service for users in the separated regime is more service-intensive.

Let $\chi_s$ and $\psi_s$ denote users’ cost-minimizing method of producing a unit of $z$ in the separated regime, given $r_s$. Since equipment is relatively more expensive in this regime, we have $\chi_s < 1$ and $\psi_s > 1$. Users’ (constant marginal) cost of producing a unit of $z$ is $r_s \chi_s + \psi_s$.

How does welfare in the separated regime compare to that in the integrated regime? Interbrand systems competition in the integrated regime and interbrand equipment competition in the separated regime keep the regime change from affecting profits; all firms earn zero profit under both regimes. Thus, any change in total welfare from the regime change is assessed by examining the effect on equipment users. The latter effect is found by comparing the price users pay for output in the two regimes or, equivalently, the total amounts of output produced in the
two regimes. As shown below, this comparison turns on whether total output in a separated regime \( x_S / \chi_S \) is greater or less than it would be in an integrated regime for the \( n_S \) manufacturers.

\[
\begin{align*}
Proposition 1: \text{If oligopolistic interactions in the regimes are such} \\
\text{that } x_S / \chi_S &\leq n_S g(n_S), \text{ then total welfare is greater in the integrated} \\
\text{regime than in the separated regime.}
\end{align*}
\]

\textbf{Proof:} Since profits are zero in both regimes, it is only necessary to compare the welfare of users in the regimes. There are two cases to examine.

Consider first the case where the free-entry number of manufacturers is greater in the integrated regime: \( n_S < n_I \). The hypothesis implies that

\[
\frac{n_S h(n_S)}{n_S g(n_S)} \leq \chi_S. \tag{5}
\]

With \( n_S < n_I \) and with assumptions made about oligopolistic interactions in the integrated regime, we also have

\[
\frac{n_S g(n_S)}{n_I g(n_I)} < 1. \tag{6}
\]

Together, inequalities (5) and (6) imply that

\[
\frac{n_S h(n_S)}{\chi_S} < n_I g(n_I),
\]

or

\[
x_S / \chi_S < z_I. \tag{7}
\]

Inequality (7) indicates that the total quantity of \( z \) produced in the integrated regime exceeds that produced in the separated regime. Accordingly, the welfare of users is greater in the integrated regime.
Now consider the case where the free-entry number of manufacturers in the separated regime is greater than or equal to that in the integrated regime: \( n_S \geq n_I \). With \( n_S \geq n_I \), we have

\[
g(n_S) \leq g(n_I)
\]

from assumptions made about oligopolistic interactions in the integrated regime. Inequality (8) and the hypothesis combine to yield

\[
h(n_S)/g(n_I) \leq \chi_S,
\]

which implies

\[
[F/h(n_S)] \leq F/g(n_I)
\]

Further, as \( f(x, y) \) is quasi-concave, input combinations \((\chi_S, \psi_S)\) and \((1, 1)\) must satisfy

\[
\psi_S - 1 > c(1 - \chi_S).
\]

Together, inequalities (9) and (10) establish that

\[
[c + F/h(n_S)] \chi_S + \psi_S > c + 1 + F/g(n_I).
\]

Using equations (1) and (4a), inequality (11) becomes

\[
r_S \chi_S + \psi_S > p_I.
\]

Inequality (12) indicates that the cost to users of producing units of \( z \) in the separated regime exceeds the price of \( z \) in the integrated regime. Accordingly, the welfare of users is greater in the integrated regime. §

Switching from an integrated regime to a separated regime affects welfare in two ways. First, in the separated regime, service and equipment prices are distorted and fall short of the Ramsey-optimal benchmark. This distortion induces equipment users to overutilize equipment and to purchase too much service. In the integrated regime, component prices are not distorted and output is produced more efficiently.
The second effect of a regime switch is linked to differences in oligopolistic interactions in the regimes and to attending changes in the number of manufacturers. In principle, the second effect could work in either direction. If oligopolistic interactions were more competitive in the integrated regime than in the separated regime, then switching to the separated regime would damage market performance, *ceteris paribus*. If oligopolistic interactions were less competitive in the integrated regime, then switching to the separated regime would improve market performance, *ceteris paribus*.

The combined effect on welfare of switching to the separated regime would be injurious to market performance if vertical integration makes interactions more competitive. But if vertical integration makes interactions less competitive, the combined effect depends on whether this beneficial effect of separation is large enough to offset the damage caused by the service-for-equipment distortion.

The hypothesis $x_s / x_s \leq n_S g(n_s)$ puts a bound on how competitive oligopolistic interactions must be in the separated regime, as compared to the integrated regime, for our welfare result to follow. An interpretation of this condition is that the total output of $z$ in the separated regime must not be more than would be produced if the manufacturers in that regime were integrated. It would be idle to contend that this inequality is a general condition, certain to hold in every case. But the condition demonstrates that total welfare is greater in the integrated regime unless vertical integration *per se* has a significant chilling effect on oligopolistic interactions among the firms.

III. DISCUSSION
The main implication of our analysis for antitrust policy is that equipment manufacturers’ practices that deter ISOs -- practices challenged in numerous antitrust cases -- actually can improve rather than harm market performance. Systems competition without ISOs can be superior to a regime with ISOs and intrabrand service competition because systems competition drives equipment and service prices to Ramsey-optimal levels. Whenever there are variable proportions in the production of output from equipment and service, fixed R&D and production set-up costs should be distributed over both components instead of just one. Intrabrand service competition from ISOs forces manufacturers to shoulder their fixed costs on equipment sales alone. This leads to sub-optimal pricing of both equipment and service and induces customers to purchase too little equipment and too much service. This distortion raises the cost of using equipment non-negligibly and reduces the welfare of equipment users.

The positive welfare effect of preventing downstream input-substitution distortions in our model is not a general result of course. Consider four qualifications.

A. A MANUFACTURING MONOPOLIST

Our result stems from competition in the equipment market. If the equipment market were cartelized or monopolized, the result would not necessarily survive. Consider a hypothetical monopolist who produces an input that is combined downstream with a second input in variable proportions where the second input is sold under conditions of perfect competition. In this situation, it would be advantageous for the monopolist to tie the competitive input to the monopolized input so as to eliminate the input-substitution distortion and increase its profits (Vernon and Graham). But the tie may or may not improve aggregate welfare. It is possible that
the monopolist’s conduct, although privately optimal, would reduce output and welfare in the downstream market. The trade-off between the gain to the monopolist and the loss to customers downstream means the sign of the net welfare effect is ambiguous (Warren-Boulton, and Mallela and Nahata).

In our model, there is no countervailing welfare loss. This is because equipment manufacturers in our model lack monopoly power in the sale of equipment and service. Systems competition competes upstream equipment profits away and sends all the benefits of efficient production downstream to equipment users.

B. THE NUMBER OF MANUFACTURERS IS REGIME INVARIANT

Another assumption we make about competition in the equipment market is that free-entry conditions prevail in that market. If this assumption is replaced, such that the number of manufacturers is \( n \) in each regime, our result is not as strong. Since we are not able to sign the effect of a regime change on profits, we cannot predict the effect of a regime change on total welfare. Nevertheless, the integrated regime remains superior as far as users are concerned if the total quantity of \( z \) produced in the segregated regime is no more than that produced in the integrated regime.

\[ \text{Corollary: If oligopolistic interactions in the regimes are such that} \]

\[ nh(n)/z_s \leq ng(n), \text{ then user welfare is at least as great in the integrated regime as in the separated regime.} \]
C. MAINTENANCE COSTS

While our model assumes no fixed costs are incurred in providing repair and maintenance service, this is not essential to our argument. All that is needed for our result is that components’ fixed costs combine to create a divergence between break-even price levels, taking components on a stand alone basis, and Ramsey-optimal price levels. Virtually any configuration of fixed costs (except no fixed costs at all) would create such a divergence. The antitrust cases where ISOs are an issue typically involve high-tech equipment where manufacturers incur sizable fixed costs for R&D and initial production set up.

The model assumes that in the separated regime, ISOs’ costs of servicing equipment are the same as manufacturers’ costs. This means ISOs are neither more or less efficient than manufacturers’ service operations. J. Farrell, H. K. Monroe, and G. Saloner find that systems competition is not superior to competition in separate markets for components in a heterogeneous-cost oligopoly model, but their demonstration requires components to be used in fixed proportions. To see how heterogeneous costs affect the equipment-service distortion, suppose learning by doing or economies of scope between manufacturing and servicing equipment put ISOs at a cost disadvantage. If ISOs suffer a service cost disadvantage in the separated regime, such firms might not be viable even if manufacturers abstain from practices that otherwise deter ISOs. In this case, the distortion and welfare loss in the separated regime would be less than indicated previously because service prices would not be driven down to the level of manufacturers’ marginal cost. Service prices would only be driven down to levels that deter inefficient ISOs from providing service.
D. PROPRIETARY INPUTS

Finally, in many of the industries where manufacturer practices discourage intrabrand service competition, ISOs must purchase proprietary replacement parts or software from particular manufacturers in order to provide brand-specific service. These requirements enable the manufacturer to affect an ISO’s cost of providing service. If the proprietary inputs are used in variable proportions in servicing equipment, then the manufacturer would not be able to raise the price of the input to ISOs without triggering the “inefficient service” distortion identified by Chen and Ross (1998). By raising proprietary input prices, the manufacturer can only reduce the service-for-equipment distortion by ushering in the “inefficient service” distortion.

Of course, it is possible in some cases that inputs are not used in variable proportions in servicing equipment. If service requires use of a proprietary input in fixed proportions, then the manufacturer could sell (or license) the input to ISOs on terms that prevent the service-for-equipment distortion. To do this, the manufacturer would set the price of the proprietary input at a level that raises ISOs’ cost of servicing equipment to equality with the Ramsey-optimal price of service. Under these conditions, a manufacturer would be able to sustain Ramsey-optimal pricing of equipment and service in the separated regime since ISOs would be forced to participate in fixed cost recovery via mark ups on the indispensable input. In any case, no

\[\text{12} \quad \text{This kind of pricing is analogous to Baumol and Sidak’s proposal for efficient interconnection charges by a local telephone company.}\]

\[\text{13} \quad \text{Klein (1993) suggests that this scenario is unlikely in many industries because of input substitution possibilities embodied in the service technology.}\]
measure that forces manufacturers to sell (or license) proprietary inputs to ISOs can outperform systems competition.

IV. CONCLUSION

In the post-Kodak world of antitrust, litigants avidly contest the economic implications of competition between manufacturers and ISOs in derivative markets. One avenue of judicial thinking now interprets Kodak as pivoting on whether a manufacturer changed its parts and service policies mid-stream. An important post-Kodak appellate opinion held that “an antitrust plaintiff cannot succeed on a Kodak-type theory when the defendant has not changed its policy after locking-in some of its customers, and the defendant has been otherwise forthcoming about its pricing structure and service policies.”

While this is an important limitation on Kodak, it is unfortunate if it means manufacturers are precluded from changing business policies when the effect would be to strengthen systems competition. Such a change need not be opportunistic in the Kodak sense of the term. Moreover, this limitation places an unfortunate premium on "getting it right" the first time in establishing an aftermarket policy, and penalizes firms for learning from experience (Alchian).

One veteran of Kodak litigation has asked “whether there are any legitimate aftermarket monopoly theories that do not involve opportunistic policy changes” and then indicated that the “leading alternative theory is enhanced price discrimination.” (Wall, p. 35.) This paper presents

\[\text{Note:}\]

\[\text{14 PSI Repair Service, Inc. v. Honeywell, Inc., 104 F.3d 811, 820 (6th Cir. 1997).}\]
a theory of ISO exclusion that involves neither price discrimination\textsuperscript{15} nor lock-in exploitation. Our explanation derives from the economic theory of multi-product pricing where there are substantial fixed costs associated with any or all of the products. This characterization applies to most (if not all) of the industries where ISO presence has provoked antitrust litigation.

Opportunities for exploiting locked in customers in service aftermarkets are very limited. But this does not mean it is a matter of indifference whether there is intrabrand competition in those aftermarkets. Interbrand systems competition without ISOs curbs price distortions and, under plausible conditions, confers more benefits on customers than intrabrand service competition with ISOs. The underlying logic of manufacturers’ practices that foreclose ISOs from service aftermarkets is not to exclude competitors but to compete more effectively on a systems basis.

\textsuperscript{15} Ramsey pricing allows differential margins on system components but does not require price discrimination between customers. Even with identical customers, there are welfare gains from an integrated regime.
APPENDIX A

Selected ISO Antitrust Cases

Spectrofuge Corp. v. Beckman Instruments, Inc., 575 F. 2d 256 (5th Cir. 1978).


In re Data General Corporation Antitrust Litigation, 190 F. Supp. 1089 (N.D. Cal. 1980).


Data General Corp. v. Grumman Systems Support Corp., 36 F. 3d 1147 (1st Cir. 1994).

Datagate, Inc. v. Hewlett-Packard Co., 672 F. Supp. 1288 (N.D. Cal. 1987); 911 F. 2d 861 (9th Cir. 1989) 1993 WL 762710 (N.D. Cal.).


Triad Systems Corp. v. Southeastern Express Co., 1994 WL 446049 (N.D. Cal.); 64 F. 3d 1330 (9th Cir. 1995).


Digital Equipment Corp. v. UNIQ Digital Technologies, Inc., 73 F. 3d 756 (7th Cir. 1996).


REFERENCES


