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TYING AS QUALITY CONTROL: A LEGAL AND ECONOMIC ANALYSIS

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ABSTRACT

Commentators have suggested that where two products are used in conjunction with one another (such as machines and aftermarket parts and service), tying good suppliers may establish a tie in order to protect the tying good’s reputation for quality against the damaging effects of low-quality service. This article provides support for the courts’ generally skeptical response to this explanation. In some circumstances purchasing inferior tied goods from independent suppliers may enhance the tying good’s reputation and expected profits. In other circumstances externalities may arise that provide a quality-control rationale for tying; however, these externalities are imposed on the seller not by independent suppliers but by purchasers of the tied good. The article describes the conditions required for the quality-control explanation to be plausible and provides a context for the theory and its legal implications by examining a sample of U.S. tying cases.
1. INTRODUCTION

Tying occurs where the seller of a good (the “tying” good) induces or requires buyers to purchase in addition a second good (the “tied” good) from it. In this article, I consider one of the efficiency explanations for the practice: it serves as a quality control device where the tied good is used in conjunction with the tying good. This situation arises frequently in “aftermarkets,” which are the markets for parts or service used in conjunction with original equipment already purchased.

In the United States, the law on tying is not precise in defining the role of efficiency explanations. When certain conditions are met, tying is *per se* illegal, yet efficiency justifications are influential in a number of ways. First, efficiency may be important in determining, as a legal matter, whether there are actually two products to be tied. For example, the economies of joint provision suggest that requiring consumers to purchase a left shoe along with a right shoe should not be unlawful, nor would it be treated as such under U.S. law: the left

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2 Courts vary in their requirements to find a tying arrangement *per se* illegal. Hovenkamp, supra at 351 suggests that the Courts choose either the following list (from *Yentsch v. Texaco, Inc.*, 630 F.2d 46 (2d Cir. 1980) at 56-57) or a subset thereof (with near unanimity on requirements 1, 3 and 5): “1) There must be separate tying and tied products; 2) there must be ‘evidence of actual coercion by the seller that in fact forced the buyer to accept the tied product…’ 3) the seller must possess ‘sufficient economic power in the tying product market to coerce purchaser acceptance of the tied product…’; 4) there must be ‘anticompetitive effects in the tied market…’; and 5) there must be involvement of a ‘not insubstantial’ amount of interstate commerce in the tied product market…”
3 *Jefferson Parish Hosp. Dist. No. 2 v. Hyde*, 466 U.S. 2 (1984). If tying in a particular case is found not to be *per se* illegal, the rule of reason may apply, in which case efficiency justifications will clearly be relevant.
and right shoe would be treated as parts of a single product.\(^5\) Second, efficiency may be relevant when initially determining whether the tie is \textit{per se} illegal. \textit{International Salt}, for example, involved a machine supplier requiring lessees to purchase an input from it, thus allegedly tying input sales to the machine lease.\(^6\) While characterizing tying as \textit{per se} illegal, the Court observed without further explanation that, “Of course, a lessor may impose on a lessee reasonable restrictions designed in good faith to minimize maintenance burdens and to assure satisfactory operation.”\(^7\) Third, efficiency may also be important as an explicit defense. Along with similar approaches in other courts,\(^8\) the Ninth Circuit, for example, has established that “antitrust defendants may demonstrate a business justification for an otherwise \textit{per se} illegal tying arrangement.”\(^9\) There may be little difference between the second and third uses of efficiency. Before determining whether a practice is \textit{per se} illegal, courts often conduct a preliminary analysis into the likely welfare effects of the arrangement.\(^10\) Whether efficiency enters the analysis in the initial determination of \textit{per se} illegality, or as an explicit defense, the result may be similar.

This article focuses on the quality control explanation for tying. Several commentators suggest that tying may be efficient in protecting the seller’s reputation for quality.\(^11\) If inferior

\(^5\) Hovenkamp, \textit{supra} at 367.
\(^6\) \textit{International Salt Co. v. United States}, 332 U.S. 392 (1947). I will discuss this case in detail below.
\(^7\) \textit{Id.} at 397.
\(^9\) \textit{Mozart Co. v. Mercedes-Benz of North America Inc.}, 833 F.2d 1342 (9th Cir. 1987) at 1348.
tied goods are used in conjunction with the tying good, poor joint performance of the goods results. The buyer, however, is unable to distinguish whether poor performance reflects a poor quality tying good, or a poor quality tied good. As a result of this confusion, the seller imposes the tie, thereby assuring that shoddy tied goods will not hurt its reputation for high quality tying goods.

Courts have generally been skeptical about this justification for tying. Representative is the following from the Supreme Court in *Standard Oil*:

Tying agreements serve hardly any purpose beyond the suppression of competition. The justification most often advanced in their defense – the protection of the good will of the manufacturer of the tying device – fails in the usual situation because specification of the type and quality of the product to be used in connection with the tying device is protection enough. If the manufacturer’s brand of the tied product is in fact superior to that of competitors, the buyer will presumably choose it anyway. The only situation, indeed, in which the protection of good will may necessitate the use of tying clauses is where specifications for a substitute would be so detailed that they could not practicably be supplied.12

I contend that the protection of goodwill explanation generally deserves the skepticism accorded it by the courts, although not for the reasons courts usually state. Courts, as in *Standard Oil*, usually reject the goodwill explanation because there are alternative means of ensuring quality tied goods, such as providing technical specifications. In my view, the goodwill explanation can be rejected in many circumstances because it fails to account for buyer rationality.

To understand the role of buyer rationality, note that there are two candidate externalities that the tie may address. The first externality is between independent producers of the tied good


12 *Standard Oil Co. of California and Standard Stations Inc. v. United States* 69 S.Ct. 1051 (1949) at 1058.
and the producer of the tying good. The independent producer of the tied good does not realize
the benefits associated with the tying good’s reputation for high quality. The benefits from
reputation accrue to the tying good provider itself. Consequently, when choosing quality, the
independent tied good producer does not account for the harm of low quality tied goods to the
value of the tying good’s reputation. The independent thus has attenuated incentives to produce
high quality tied goods because of an externality. While independents may have attenuated
incentives to provide high quality tied goods, this is not a satisfactory explanation of the tie
because it fails to account for buyer rationality. Buyers will anticipate that independents do not
realize the full benefits of the tying good’s reputation and those who value high quality tied
goods will therefore seek to buy from the producer of the tying good, who internalizes the
benefits of reputation. There is, in general, no need to tie to protect reputation.

This does not complete the story, however, since there is a second potentially important
externality. The buyer of the tying and tied goods also does not realize fully the benefits of the
tying good’s reputation for quality. There is an externality to be addressed because the buyer
does not account for the harm to the seller’s reputation from its (knowing) purchase of poor
quality tied goods from independents. The tie may respond to this externality. I will call this the
“confusion externality,” referring to its source: the confusion buyers have about the source of
poor performance and the assignation of some blame to sellers of the tying good. If buyers were
not confused about the source of poor performance, there would be no significance to the buyer-
seller externality. Blame would be assigned to either the tying or tied good, depending on the
problem. Consequently, there would be no effect from the purchase of inferior tied goods on the
tying good’s reputation.
Section 2 analyzes the adoption of tying as a response to the confusion externality. In particular, Section 2 derives conditions for when the effects on the tying good’s reputation of a buyer’s decision to use an independent supplier of the tied good are negative and thus when there may be a plausible confusion externality explanation of tying. These conditions are fairly restrictive, which supports the courts’ generally skeptical attitude to this explanation of tying. Indeed, it will be shown that in some circumstances, purchasing low quality tied goods will on average enhance the reputation of a high quality tying good, leaving a tie unnecessary to correct for an externality. The positive effect arises because, in some cases, if purchasers enjoy high quality performance of the tying-tied good package, the lower the quality of the tied good, the higher their post-use estimate of the tying good’s quality. Section 2 shows that the likelihood of this positive effect dominating depends significantly on the technological relationship between the tying and tied goods.

Section 3 describes a different externality that provides a quality control explanation of tying in some circumstances. The tie may respond to perverse incentives for the buyer knowingly to purchase inferior tied goods that result where the seller directly bears some of the costs related to the tying good’s performance. This cost-sharing may result from a guarantee of satisfactory performance by the tying good supplier, for example, or it may result because of the reputational harms to a franchisor from a franchisee’s poor performance. I will refer to this as the “cost-sharing externality.” Section 4 discusses a sample of relevant cases. The cases illustrate the tendency of courts to reach reasonable outcomes with respect to quality-control explanations of tying, but also provide examples of where the courts are imprecise on the particular externality

involved. For example, the cost-sharing externality may be an important factor even where the court seems to rely on the confusion externality. Section 5 concludes the article by discussing the legal implications of the analysis.

2. THE CONFUSION EXTERNALITY EXPLANATION OF TYING

The argument I seek to challenge is that tying is necessary to ensure that customers are not fooled into discounting the quality of the tying good as the result of the unwitting use of inferior tied goods. I first set out the necessary conditions for the confusion externality to apply and show that when buyer rationality is taken into account, these conditions imply that buyers who prefer high quality tied goods will tend to purchase from the tying good supplier even without a tie. This does not resolve the matter, however, since buyers who knowingly purchase low quality tied goods may harm the tying good’s reputation. That is, a tie may be useful as a response to a confusion externality imposed on the seller by the buyer. I will consider two cases where the tie may serve this purpose. First, when the relationship between the quality of the tying and tied goods is determinative of the package’s performance, customers will generally (but not always) be able to infer the quality of the tied and tying goods perfectly and there are only limited circumstances where a tie responds to quality-control issues. Second, when there is a stochastic relationship between quality and performance, a confusion externality can arise. I clarify the factors that underlie this externality and show that the confusion externality is plausible only in a narrow set of circumstances.
(a) Necessary (But Not Sufficient) Conditions for the Confusion Externality

As commonly described, for the confusion externality to exist, one requirement is that the buyer cannot physically distinguish the quality of the tied good prior to purchasing the tied good. If she could, a buyer who cared about high quality would simply purchase the quality of tied good she desires. Since the confusion externality depends on buyers imposing costs on sellers, however, the ability of the buyer to identify the tied good’s quality may not resolve the confusion externality; a buyer may knowingly purchase low quality tied goods without accounting for a negative reputational effect on the seller of the tying good.

A requirement that is necessary is that the buyer cannot tell the difference between the quality of the tied good and the quality of the tying good \textit{ex post}; that is, after the tied good has been used in conjunction with the tying good. If she could, poor performance as a result of inferior tied goods would simply reflect badly on the tied good supplier. Moreover, for the confusion externality to cause harm to the tying good supplier, it must be that a reputation for quality is valuable. If reputation is irrelevant, perhaps because buyers do not care about high quality products, there is no need to tie - reputation is not worth protecting.

These conditions suggest that a seller may be harmed by its customers’ use of poor quality tied goods. These conditions also suggest, however, that the buyer who prefers a high quality tied good will simply choose to purchase from the supplier of the tying good. The buyer knows that she is at the mercy of the seller of the tied good in purchasing the good when it comes to quality - she cannot tell \textit{ex ante} or \textit{ex post} the quality of the good. \textit{Ex post}, the buyer can only infer the quality of the package. The party that has the most to lose with respect to the reputation of the package is the tying good supplier, given that, by assumption, a reputation for quality tying goods is valuable. Therefore, notwithstanding her inability \textit{ex ante} to determine
whether the tying good supplier’s tied goods are superior in quality to others’, the buyer who
cares for high quality tied goods will anticipate that she should purchase the tied goods from the
tying good supplier.

This does not, however, completely answer the question of whether the tie can respond to
an externality. While customers who care for high quality will purchase tied goods from the
tying good supplier, thus rendering the externality between independent suppliers of tied goods
and the tying good producer unimportant, it remains true that those who care less about quality
will not account for the tying good supplier’s reputation when buying tied goods. The buyer
imposes an externality on the tying good seller. In only in a limited set of circumstances,
however, will this externality result in any harm to the tying good supplier. I first consider the
case where the quality of the tied good and tying good are determinative of the package’s
performance, and then the case where there is a stochastic relationship between quality and
performance.

(b) Determinate Case

Suppose the tying good is a machine and the tied good is maintenance services. The
quality of the machine can either be high or low; the quality of the service can either be high or
low. Assume that the user of the machine cares about quality in the following way. Aside from
the price of the machine and the maintenance services, there is a cost associated with the quality
of the package; poor quality imposes costs on the user, perhaps because of the opportunity cost
of “down-time.” Assume these costs to be the following:
These costs reflect possible confusion over quality: if the “down-time” costs of the machine were 100 and the buyer did not know the quality of either the machine or service explicitly, she would not be able to infer whether the quality of the machine or the service were low. Note that the symmetry of the cost structure is crucial for the potential externality. If poor quality service and a poor quality machine affect down-time in an asymmetric way (for example, if high machine quality and low quality service imply downtime costs of only 60), the quality of each input could be inferred directly from the performance.

Assume that the cost to the maintenance supplier of providing low quality maintenance is 10, while high quality maintenance costs 40 to supply. In these circumstances, a “lemons” problem would face independent suppliers of maintenance services. Customers would not know the quality of service \textit{ex ante}, nor is there the bond of the machine’s reputation to ensure that independents have a strong interest in the customers’ assessment of the quality of the package \textit{ex post}. Customers will therefore discount any claim to quality made by an independent. Indeed, assuming a competitive market for tied goods, customers will expect low quality from an independent at a price of 10.\footnote{See G. Akerlof, “The Market for Lemons: Quality Uncertainty and the Market Mechanism” (1970) 89 Quar. J. Econ. 488.}

\footnote{If independent suppliers could develop reputations for quality that were valuable, then the tie again would not be needed to respond to the externality between independent tied good suppliers and the tying good supplier: those customers seeking quality tied goods will purchase from suppliers with a reputation for quality. Of course, for an introductory tying good, there may be uncertainty about whether a reputation for quality tied goods will emerge. I will discuss this possibility below.}
The machine manufacturer, however, wants to protect its reputation for quality machines. The only way to ensure this reputation is to offer high-quality service. If the buyer faces “down-time” costs of only 50 for the machine-service package, it will infer that the package is of high quality; if not, the machine-service package is not high quality.¹⁶ Notwithstanding the absence of a tie, therefore, a customer who cares about high quality would prefer hiring the manufacturer for service: the marginal cost of high quality service relative to low quality (between 30 and 40, depending on the price of high quality service which will be between 40 and 50) is lower than the marginal benefits (“down-time” costs reduced by 50).

Thus, while both the manufacturer and an independent servicer would have an incentive to “cheat” and offer low quality maintenance even while charging for high quality service, the manufacturer faces the countervailing consideration of its reputation for high quality machines. Reputation for high quality tying goods serves as a bond to commit the manufacturer, but not the independent servicer, to provide high quality service.

Note that if there were some customer for whom the benefits of high quality service were less than the costs, it may prefer low quality service at a price of 10. Nevertheless, there would not be a confusion externality. Since it anticipates that the independent operator has only attenuated incentives to provide high quality service, it will assess the quality of the machine on the assumption of low quality service. Thus, in the example above, a “down-time” cost of 100 would indicate a high quality machine. Even though the customer does not account for the reputational effects on the manufacturer when purchasing tied goods, there is no negative externality because the quality of the machine can be accurately inferred.

¹⁶ I assume throughout that the supplier’s reputation for quality in either service or machine affects the supplier’s reputation for quality generally - given the confusion over the source of the
This example rebuts some of the arguments made in support of the confusion externality explanation of tying. Bork acknowledges the argument that users of the tying good would generally share the manufacturer’s interest in ensuring optimal operation of the tying good, but suggests two reasons why there may remain a justification for tying based on the confusion externality. First, there are information costs. Second, there are policing costs.

The information costs point rests on the assertion that many of the products that have involved tying are complex machines. Explaining the technical virtues of the manufacturer’s own service, for example, and why it is superior to independents’, may not be easy. As Bork states, “Despite the law’s easy assumption that the lessor can persuade the lessees to take his related product, this may not be easy. The provision of information to numerous lessees will be expensive, and some of them may be skeptical of the lessor’s arguments.” The response invited by the simple example above is that the user of the tying good (the lessee in Bork’s discussion) need not have any idea about the technical complexities of the service in question to know the quality of service the manufacturer (lessor) will provide relative to the independent. The manufacturer has a bond assuring the optimality of its performance: future rents from future machine sales. The independent does not. Therefore, there is no need for the manufacturer to spend money to convince users of the tying good to purchase its services; the bond represented by reputational rents speak for themselves.

Bork’s second argument in support of the confusion externality explanation of tying is that the seller of machines would have to expend resources policing the quality of the service

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17 Bork, supra at 380.

18 Ibid.
provided by independents. In opposing many courts’ stated view that writing specifications may substitute for tying,\textsuperscript{19} Bork states, “The writing of specifications and the continual policing required to make sure they are complied with is also certain to be more expensive than supplying the related good oneself.”\textsuperscript{20} While the courts’ position may not account for Bork’s concern about the cost of policing, his position is itself unconvincing. Just as there was no need to spend money providing information to customers, there is little need to spend money policing the quality of service. Consumers purchasing from independent service providers will recognize that these independents have attenuated incentives to provide high quality service. If they purchase from the independents, they will anticipate lesser service and thus will not be fooled in the event of the machine’s poor performance. There would not be a confusion externality that would justify a tie. The courts’ skepticism of this argument, while perhaps misdirected, is sound in the result.

It might be objected that the example set out above relies too much on customer sophistication about the costs and benefits of machines and service of different quality. That is, suppose the buyer knew only that quality of both the machine and the service can affect the machine’s performance to some extent, but does not know precisely to what extent the effects matter. Would not the customer be tempted to hire cut-rate service providers?

Even in the absence of precise information about the costs and benefits of quality, generally buyers should nevertheless recognize the incentives to provide quality. Assuming that a reputation for a high quality machine matters, the manufacturer of a high quality machine would have some incentive to provide high quality maintenance. The customer may not know

\textsuperscript{19} See, e.g., \textit{Standard Oil}, \textit{supra}.

\textsuperscript{20} Bork, \textit{supra} at 380. See also Posner and Easterbrook, \textit{supra} at 808-9.
precisely the *relative* quality of the machine or service that it is getting, given that (by a tenuous assumption) it does not know how a quality machine should operate, but it will know the *absolute* quality of the machine and service package and this will affect its willingness to purchase another machine in the future. The manufacturer internalizes the effects on its customer to some extent through the future rents it could earn as the result of a reputation for quality. Consequently, the customer will generally trust the manufacturer in buying the tied good where the buyer knows that quality service matters to the operation of the machine, that quality can vary and that the manufacturer would seek to preserve a reputation for the quality of its machines.

Possible support for the confusion externality justification for tying could arise where there is a deterministic relationship between quality and performance would occur where, notwithstanding this deterministic relationship, customers are ignorant entirely of the fact that service affects the machine’s performance. In certain circumstances, the customer may then not purchase the manufacturer’s service. In particular, it must be the case that the manufacturer has some incentive to mislead its customers about the optimal service to buy. Where the tied and tying goods are used in fixed proportions, it is not clear why the manufacturer would have an incentive to mislead: to the extent that the manufacturer is able to reap a higher price for service by misleading, it is unable to charge a higher price for machines. This is the familiar response to the leverage theory of tying. However, there may be cases where the manufacturer would prefer to charge a supra-competitive markup on the tied goods. For example, if the customer estimated that service were unimportant to the operation of the machine, she may not buy the manufacturer’s service on the thinking that the manufacturer was seeking to price discriminate

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21 Bowman, *infra*. 
among buyers by charging a price for services above the marginal cost of providing services: demand for services serves as a proxy for the intensity of the buyer’s demand for the machine-service package.\textsuperscript{22} If the buyer has little knowledge of the effect of service on the machine, then it may not buy from the manufacturer, which would be charging a higher price whether it were the only provider offering high quality, higher cost service or it were simply seeking to price discriminate.

There are, therefore, some circumstances in which customers have sufficiently poor information that they may expect high quality service from independent service providers. The difficulties with reliance on this scenario as providing a justification for tying are two. First, there is its questionable plausibility: would buyers be confused about the importance of service to the extent that they would discount sufficiently independents’ lack of incentives to provide quality service and not buy service from the manufacturer? If buyers were so ignorant of the importance of service, it is unclear how they would even arrive at a decision to purchase a machine: how would they price the machine-service package without some conception of the importance of service? Second, where such conditions may have some plausibility, such as where there is a brand new machine without any track record, one would expect contractual arrangements beyond tying to protect the buyer. If the buyer had little notion of the likely costs of service and the machine together, while the seller has good information about them, one would expect the seller to bear a significant portion of the costs of the machine’s service and

functioning. In these circumstances, as I will explain below, tying may respond, not to a confusion externality, but to a cost-sharing externality. Thus, while it is conceivable in the deterministic case that tying could respond to a confusion externality, it is not very plausible.

Thus far in the analysis, I have not specifically identified how the reputation for quality arises. Does a customer’s experience with the tying and tied goods affect only its own perception of the product, or does it also affect other customers’ perceptions? Regardless of the answer, where quality is determinative of performance, it is unlikely that there is a confusion externality that justifies a tie.

If the customer’s experience affects only its perceptions, the value to the supplier of the reputation of the quality of the tying good will depend on whether the customer is likely to purchase another tying good in the future. If it is, the value of reputation will be higher and this will provide a bond which helps commit the manufacturer to provide high quality tied goods; thus, the customer will be drawn to the manufacturer to purchase the tied good and no tie is necessary. If the customer is unlikely to purchase another tying good in the future, then the value of the reputation vis-à-vis the customer is not particularly valuable. There is less of a bond for the manufacturer to provide high quality tied goods. Given the absence of a bond (and, by assumption, the absence of reputational effects external to the customer), the manufacturer itself is therefore less likely to provide high quality tied goods. In these circumstances, the tie would not be imposed to protect the manufacturer’s reputation with the particular customer, given that the reputation is not worth much. Therefore, where the performance of the tying and tied goods affects only the customer’s perception of quality of the tying good, a tie is unnecessary to preserve reputation: if the customer is likely to purchase a tying good again, it will recognize the manufacturer’s incentives to provide high quality tied goods without a tie; if the customer is
unlikely to purchase again, there is no use in tying to protect reputation since reputation has no value.

Consider now where there is an external effect on other customers’ perceptions of the tying good’s quality as a result of the tying and tied goods’ performance. Whether or not the customer intends to buy the tying good in the future, the supplier has a bond for the quality of its service because of other future sales of the tying good. Hence, the reputational incentive to provide quality service by the manufacturer will help bond it to provide high quality tied goods. Any customer seeking high quality tied goods will therefore purchase from the manufacturer regardless of a tie.

Suppose, however, that there is a subset of customers who prefer low quality tied goods - the costs of high quality tied goods exceed the benefits. In this circumstance, there will be an externality between this individual buyer and the seller of the tying good. The buyer will not account for any harm to the seller’s reputation among other buyers in considering whether to purchase low or high quality tied goods. If there were harm to the seller’s reputation, a tie might respond to the externality. It may be worthwhile for the seller to raise the price of the tied/tying good package by imposing a tie, even if some customers would prefer low quality tied goods, in order to preserve a reputation for quality. However, where quality is determinative of performance, it is unlikely that there would be harm to the seller’s reputation.

Buyers of the tying and tied goods know that the quality of the performance of the package is affected both by the intrinsic quality of the tying good and the quality of the tied good used in conjunction with it. For outside observers to conclude that a tying good was of low

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23 As noted in the example above, if customers are not aware of the importance of service to the quality of the machine’s operation, there would likely be contractual arrangements which put the risk of the machine’s proper operation on the seller. In this situation, there would be a cost-
quality, it would clearly be relevant what type of tied good was used in conjunction with the tying good. Thus, an outside observer in the example of the machine set out above, observing that a machine cost its user 100, would want to know whether the user purchased tied goods from the seller (in which case, there would have been a bond to supply high quality tied goods) or from an outside supplier (in which case, lower quality tied goods would be expected because of a lemons problem). Without knowing from whom the services were purchased, the observer cannot directly infer the quality of the machine from observing its cost of 100. Thus, the observer would also find out who supplied the services before judging the quality of the machine. If the observer is successful in determining the service supplier, there is no harm to the manufacturer from a confusion externality since there is no reputational cost to faulty operation of the machine when inferior tied goods were purchased.

Even if the assumption is made that while the outsider can observe the performance of the machine, it cannot observe the source of service (notwithstanding that performance, one would suppose, is more difficult to monitor than the identity of the service provider), it remains the case that there is unlikely to be a reputational cost to a high quality manufacturer from the purchase of low quality service from an independent. Observing a cost of 50 or 150 indicates a high and low quality machine respectively without requiring observation of the service supplier’s identity. Observing a cost of 100 would tend to lead to the inference of a high quality machine without direct observation of the service supplier’s identity. This is because independents are assumed to provide low quality service, a high quality machine supplier would likely want to ensure its reputation for quality by offering high quality service, and a low quality machine supplier would tend to offer low quality service, given that its reputation for quality will not be

sharing externality which may justify the tie, but not the confusion externality *per se*; see
particularly valuable. Thus, observing a cost of 100 will tend to indicate a high quality machine
even accepting the assumption that outsiders can observe performance but not the identity of the
tied good supplier.

To summarize, the confusion externality explanation of tying suffers from the following
flaw. If the explanation were to hold, it would be because manufacturers care about perceptions
of quality - the reputation for high quality tying goods is valuable and worth protecting. But
where reputation for quality of the tying good is valuable, the manufacturer can commit to the
provision of high quality service in a way independent sellers of the tied good cannot; therefore
the tie will generally be unnecessary for customers seeking high quality performance. Customers
relatively indifferent to high quality performance may purchase tied products from independent
suppliers, but this should not have adverse effects on the machine’s reputation: observers would
recognize the use of inferior tied goods and would infer the quality of the machine accordingly.

This analysis depends importantly on customers anticipating accurately a lemons
problem among independent suppliers of service. That is, customers know that suppliers will
supply only low quality service. This may not always hold. For example, it may be that there is
some probability that service providers will attempt to earn a reputation for quality. Where this
reputation for quality exists, buyers seeking high quality service will purchase from either the
machine seller or high quality service providers and there should be no externality (assuming the
reputation for high quality has been earned). However, if at any point in time there is
uncertainty on the part of customers whether a service provider will seek to earn a reputation for
quality, there may be a non-zero, but less than one, probability that the independent service
provider will offer high quality service. This in turn could complicate the inference of machine
discussion below.
quality if costs of 100 are observed. Customers updating their beliefs about quality on the 
observance of costs of 100 may downgrade their estimate of the machine’s quality.24 The 
confusion externality may therefore be relevant where there is a positive probability of high 
quality service from an independent provider. Put another way, where there are “noisy rational 
expectations” about independent service quality, there may be a confusion externality.

The confusion externality only applies in a limited range of circumstances where quality 
is determinative of performance and where customers have good information on the 
technological relationship between quality and performance. There must be a symmetrical effect 
on performance from machine quality and service quality, there must be subset of customers 
willng to purchase predictably lower quality service, and there must be some positive 
probability of high quality service from an independent provider. And even in these cases, using 
outside service will not always lower outsiders’ estimate of machine quality and therefore 
profits; it will depend on prior beliefs about quality.25

As reviewed above, the assumption that customers are informed about the relationship 
between quality and performance seems plausible in many circumstances; otherwise it is difficult 
to price the tying-tied good package. Where it is not plausible, the confusion externality may 
apply, but only where the manufacturer has an incentive to charge supra-competitive prices for

24 To illustrate this point, let \( p \) be the estimated probability that the machine is of high quality; let \( q \) be the prior estimated probability that independent service is of high quality. Following Bayes’ rule, observing costs of 100 would lead outsiders to update their beliefs in the following way:

\[
\hat{p} = \frac{(1-q)p}{(1-q)p + (1-p)q}
\]

\( \hat{p} \) could be greater than or less than \( p \) indicating that there may be a 
confusion externality. For further discussion of Bayes’ rule and the impact of performance on 
customers’ beliefs about quality, see discussion of stochastic case in Section 2(b).

25 See note 25.
the tied good, which is unlikely for example where the goods are used in fixed proportions. Moreover, where customers’ information is poor, other contractual devices, such as guarantees of tying good performance, may lead to a justification for a tie that depends on a cost-sharing externality, not a confusion externality *per se*; I will address this possibility in Section 3. I turn now to the case where there is a stochastic relationship between quality and performance.

(c) Stochastic Case

Consider now the case where there is a stochastic relationship between the quality of the tying and tied goods and the performance of the package. High quality tying and tied goods both increase the likelihood of good performance by the package, but on occasion even high quality tying and tied products can perform badly. I will treat the relationship between quality and performance in the following way. The tying good is the machine; the tied good, service. Machine quality can either be high or low; service quality can either be high or low. Good performance of the machine/service package arises where there is no breakdown of the machine during a particular period. The relationship between the quality of the machine and service and the likelihood of a breakdown is represented by, \( f(m_i, s_j) \), where \( f \) is the probability that there is no breakdown, \( m_i \) indicates a machine of quality \( i \), (where \( i=H \) or \( L \), indicating high and low quality respectively, with \( m_H > m_L \)), and \( s_j \) indicates service of quality \( j \) (where \( j=H \) or \( L \), indicating high and low quality respectively, with \( s_H > s_L \)). \( f \) is increasing in both machine and service quality.\(^{26}\)

\(^{26}\) While I will assume that machine and service qualities can each take only two values, I will also assume that \( f(m_i, s_j) \) is continuously differentiable and monotonic over the range of possible quality values, such that the first derivatives of \( f \) with respect to \( m \) and \( s \) are always
If all customers have a preference for high quality machines and service, there is unlikely to be a need to tie to preserve reputation. By assumption, the additional cost of high quality machine and service is lower than the benefits of a lower likelihood of a breakdown for all customers. Assuming that high quality service is more costly than low quality service, and that the market for services is competitive, a lemons market problem faces suppliers of service in that customers will anticipate that it is most profitable for the independent to offer low quality service. This problem may be overcome by the manufacturer’s concern for the quality reputation of the machines. Service offered by independents will be predictably of lower quality than that offered by the machine provider because of its concern about its reputation for high quality machines.\textsuperscript{27}

A confusion externality is possible, however, in markets with customers who are relatively indifferent to high quality - that is, customers who do not find breakdowns particularly costly. These customers may purchase from independent suppliers anticipating low quality service. Even if the customers anticipate low quality service, there may be a negative effect on a high quality machine supplier’s reputation and therefore profit for the following reasons: customers have only a prior estimated probability that the machine is of high quality (and thus, if the machine is actually of high quality, underestimate the quality of the machine); the lower the quality of service, the greater the probability of a breakdown; and since there is confusion over positive: $f_m(m_i, s_j) > 0$ and $f_s(m_i, s_j) > 0$. Increasing service or machine quality or both reduces the probability of a breakdown.

\textsuperscript{27} As noted above, if there are significant information problems, for example, customers have no idea about the effect of service quality on the operation of the machine, then the confusion externality can arise from the ignorant purchase of low quality, independent service. As also noted above and discussed further below, such an information structure would invite other contractual mechanisms, for example, the machine seller may warranty performance, which in turn may give rise to a cost-sharing externality explanation of tying.
the source of the breakdown by assumption, if there is a breakdown, the customer will lower the assessment of the likelihood that the machine is high quality. Tying could address a confusion externality in that the customer relatively indifferent to quality does not account for the potential harm to the reputation and profits of the high quality machine manufacturer when purchasing low quality service from independent providers.

This is only part of the story, however. While it is true that a breakdown will result in a lower assessment of the likely quality of the machine, if there is no breakdown, there will be an upgrading of the perceived quality of the machine. The purchase of low quality service and the absence of a breakdown may imply a higher assessment of the likely quality of the machine than there would be if high quality service were purchased and no breakdown occurred. Put another way, if there is no breakdown even where service is of low quality, it may be reasonable to infer that there is a greater chance that the machine is of high quality. This implies that, contrary to conventional wisdom, the expected reputation and profits associated with a high quality machine will in some circumstances be enhanced if low quality service is purchased. Given that customers anticipate low quality service from independent suppliers, purchasing service from independent suppliers may be beneficial to machine suppliers. The confusion externality explanation of tying will not apply where this positive effect dominates.

Thus, there are two opposing effects on the machine seller when inferior service is used in conjunction with the machine. On the one hand, inferior service is more likely to lead to inferior performance, which hurts the machine seller’s reputation. On the other hand, if there is good performance even with inferior service, this could benefit the machine seller’s reputation.

\footnote{Whatever the quality of service, a breakdown is more likely the lower the quality of the machine. Therefore, a breakdown will result in a downgrading of the reputation of the manufacturer.}
The following analysis illustrates the ambiguous *ex ante* effect of the use of lower quality service on customers’ view of the probability that the machine is of high quality, and thus on the machine seller’s expected profits. The analysis also highlights some of the factors that will be important in determining the net effect of lowering service quality on the machine seller’s expected profits. If the net effect is that lower service quality enhances the machine seller’s expected profits, then a negative confusion externality does not exist and thus cannot explain tying. I will illustrate the plausibility of this outcome by presenting an example based on reasonable assumptions about technology and profits where the acquisition of lower quality service always increases the machine seller’s expected profits.

(i) **Determining the Effects of Lower Quality Service on the Machine Seller**

I assume the quality of service, $s$, to be known and therefore drop the subscript: purchasing from independent suppliers indicates low quality. On the other hand, in order to test the hypothesis that sellers of high quality machines will tie to protect their reputations, I will assume that the machine actually is of high quality, but that customers only have an estimate of the probability that the machine is high quality. Let the prior probability of the machine being of high quality held by customers be $\beta$. Let $\hat{\beta}_{NB}$ be the customer’s estimate of the probability that the machine is of high quality after using the machine without a breakdown, and $\hat{\beta}_B$ be the

29 There may be some positive probability that independent suppliers will provide high quality service in order to get a reputation for high quality service. If this is the case, customers’ estimate of service quality may not be the lowest service quality possible, but rather some probabilistic assessment of average independent quality. Assuming that outsiders have an unbiased estimate of the probability that the independent will provide high quality service, the possibility of high quality independent service does not change the analysis that follows: $s$ simply represents outsiders’ estimate of independents’ service quality. Given that they do not internalize the profits accruing to the machine, I continue to assume that outsiders’ unbiased estimate of the probability that independents will provide high quality is lower than their estimate of the machine manufacturer’s probability of providing high quality service.
probable estimate of high quality where there has been a breakdown. If there is a breakdown, following Bayes’ Rule, the posterior probability that the machine is high quality is:

\[
\hat{\beta}_b = \frac{(1 - f(m_H, s)) \beta}{(1 - f(m_H, s)) \beta + (1 - f(m_L, s))(1 - \beta)} = \frac{\beta}{\beta + \frac{1 - f(m_L, s)}{f(m_H, s)}(1 - \beta)}.
\]

This is always lower than \( \beta \) : confusion over the source of the breakdown has a negative effect on the reputation of the machine.

On the other hand, if there is no breakdown, the posterior probability that the machine is of high quality is:

\[
\hat{\beta}_{NB} = \frac{f(m_H, s) \beta}{f(m_H, s) \beta + f(m_L, s)(1 - \beta)} = \frac{\beta}{\beta + \frac{f(m_L, s)}{f(m_H, s)}(1 - \beta)}.
\]

This is always greater than \( \beta \). If there is no breakdown, the machine’s reputation improves.

The posterior probability of a high quality machine will affect the machine seller’s profits. Let \( \pi(\cdot) \) be the payoff to the machine seller from its reputation following a customer’s experience with it. Following use of the machine and the service and no breakdown, the machine seller’s payoff is given by \( \pi = \pi(\hat{\beta}_{NB}) \). Where there is a breakdown, the payoff is \( \pi = \pi(\hat{\beta}_b) \). The expected payoff (for a high quality machine) is:

\[
\Pi = f(m_H, s)\pi(\hat{\beta}_{NB}) + (1 - f(m_H, s))\pi(\hat{\beta}_b).
\]

If the buyer chooses to purchase independent service, the buyer understands that the attenuated incentives to provide service quality imply a lower level of service quality. The following expression captures the effect of changing service quality on the machine seller’s payoff:
\[
\frac{\partial \Pi}{\partial s} = \frac{\partial \pi}{\partial \beta_{NB}} \frac{\partial \beta_{NB}}{\partial s} f(m_H, s) + \pi(\hat{\beta}_{NB}) f_s(m_H, s) + \frac{\partial \pi}{\partial \beta_B} \frac{\partial \beta_B}{\partial s} (1 - f(m_H, s)) - f_s(m_H, s) \pi(\hat{\beta}_B)
\]

\[
= \frac{\partial \pi}{\partial \beta_{NB}} \frac{\partial \beta_{NB}}{\partial s} f(m_H, s) + \frac{\partial \pi}{\partial \beta_B} \frac{\partial \beta_B}{\partial s} (1 - f(m_H, s)) + f_s(m_H, s) (\pi(\hat{\beta}_{NB}) - \pi(\hat{\beta}_B))
\]

(where \(f_s(m_H, s) = \frac{\partial f(m_H, s)}{\partial s}\)). The last term on the right hand side, 
\(f_s(m_H, s) (\pi(\hat{\beta}_{NB}) - \pi(\hat{\beta}_B))\), is always positive, reflecting the intuitive result that lowering service quality by purchasing from an independent increases the probability of a breakdown and along this dimension lowers the machine seller’s reputation and profits. The first two terms, however, may be positive or negative. For reasonable specifications of \(\pi\), increasing outsiders’ estimate of the probability of high quality will always increase the machine seller’s payoff, so the \(\frac{\partial \pi}{\partial \beta_i}\), which enters both of these terms, is always positive. But the remaining components of these two terms, \(\frac{\partial \beta_{NB}}{\partial s}\) and \(\frac{\partial \beta_B}{\partial s}\), each may be positive or negative. To determine the key question, whether expected profits will rise or fall with the acquisition of lower quality service, it is therefore necessary to examine the reputational effects for the machine of using lower quality service where there is and where there is not a breakdown.

(ii) Reputational Effects When There Is No Breakdown

The technological relationship between machine and service quality is the key factor in determining the reputational effects of purchasing lower quality service. I will define \(\eta_i\) as the “elasticity of reliability with respect to service quality”: \(\eta_i = f_s(m_i, s) \frac{s}{f(m_i, s)}\). For a machine of quality \(i\), \(\eta_i\) is the percentage increase in the probability of no breakdown for a given
percentage increase in service quality. If $\frac{\partial \eta_L}{\partial m} > 0$, I will refer to machine and service qualities as being “complements in reliability,” in the sense that increasing machine quality implies a greater sensitivity of reliability (the probability of no breakdown) to service quality. If, on the other hand, $\frac{\partial \eta_L}{\partial m} < 0$, I will refer to machine and service qualities as being “substitutes in reliability,” in that increasing machine quality implies a smaller sensitivity of reliability to service quality. Whether machine and service qualities are complements or substitutes in reliability has significant implications for reputational effects where there is no breakdown.

**Complements in Reliability**

It is easy to show that:

$$\frac{\partial \hat{\beta}_{NB}}{\partial s} > 0 \text{ if and only if } \frac{f(m_L, s)}{f(m_H, s)} > \frac{f'(m_L, s)}{f'(m_H, s)}.$$ 

This condition rearranged requires that,

$$f'(m_H, s) > f'(m_L, s) \frac{s}{f(m_H, s)} \frac{s}{f(m_L, s)}.$$ 

Thus, if $\eta_H > \eta_L$, then $\frac{\partial \hat{\beta}_{NB}}{\partial s} > 0$. To express this differently, $\frac{\partial \hat{\beta}_{NB}}{\partial s} > 0$ if $\frac{\partial \eta_L}{\partial m} > 0$. When machine and service qualities are complements in reliability, customers’ estimated probability of a high quality machine will increase the higher is service quality, in the event of no breakdown.

The intuitive reason why this is so is that if machine and service qualities are complements in reliability, increasing service quality will have a greater impact on reliability the higher quality is the machine; no breakdown may therefore indicate a higher quality machine the greater the service quality. Conversely, decreasing service quality where there is no breakdown will lower estimates of machine quality where machine and service qualities are complements in reliability.
Substitutes in Reliability

On the other hand, if machine and service qualities are substitutes in reliability, that is, if
\[ \frac{\partial \eta_m}{\partial m} < 0, \] then (continuing the case of no breakdown) \[ \frac{\partial \hat{\beta}_{NB}}{\partial s} < 0. \] The intuitive reason why \[ \frac{\partial \hat{\beta}_{NB}}{\partial s} < 0 \] where machine and service qualities are substitutes in reliability is that in such circumstances lowering service quality will have a smaller impact on reliability the higher the quality of the machine; no breakdown may therefore indicate a higher quality machine the lower the service quality. The customer reasons, “since there was no breakdown with such poor service, it must be very likely that machine is of high quality.”

In short, the effect on the reputation of the machine following no breakdown depends on whether machine and service qualities are complements or substitutes in reliability. If they are substitutes in reliability, then purchasing lower quality service enhances the reputation of the machine where there is no breakdown, which in turn makes it more probable that there is no negative confusion externality that explains tying.

(iii) Reputational Effects Where There Is A Breakdown

A similar approach can be taken to estimates of quality after there has been a breakdown. Again, whether machine and service qualities are complements or substitutes in reliability is significant for the posterior estimate of the probability of a high quality machine.
Complements in Reliability

It can be shown that if machine and service qualities are complements in reliability, that is, if \( \frac{\partial \eta_l}{\partial m} > 0 \), then \( \frac{\partial \hat{\beta}_g}{\partial s} < 0 \).\(^{30}\) The estimate of machine quality after there has been a breakdown will generally be lower the higher is service quality if machine and service qualities are complements in reliability.

The intuition is the mirror image of that behind the results where there has been no breakdown. If machine and service qualities are complements in reliability, then the higher the quality of the machine, the greater the impact on the probability of no breakdown if service increases in quality. A breakdown following an increase in service quality may therefore indicate a relatively low quality machine, so \( \frac{\partial \hat{\beta}_g}{\partial s} < 0 \). Put another way, a breakdown following a decrease in service quality may indicate a relatively large increase in the probability of a breakdown from a decrease in service, which indicates a higher quality machine where machine and service qualities are complements in reliability.

\(^{30}\) Recall that \( \frac{\partial \hat{\beta}_{NR}}{\partial s} > 0 \) if and only if \( \frac{f(m_L,s)}{f(m_H,s)} > \frac{f_s(m_L,s)}{f_s(m_H,s)} \), or \( \frac{\partial \eta_l}{\partial m} > 0 \). It can also be shown that where there has been a breakdown, \( \frac{\partial \hat{\beta}_g}{\partial s} > 0 \) if and only if \( \frac{1 - f(m_L,s)}{1 - f(m_H,s)} < \frac{f_s(m_L,s)}{f_s(m_H,s)} \). But since \( 0 \leq f(m_L,s) < f(m_H,s) \leq 1 \), \( \frac{1 - f(m_L,s)}{1 - f(m_H,s)} > \frac{f(m_L,s)}{f(m_H,s)} \). So if \( \frac{f(m_L,s)}{f(m_H,s)} > \frac{f_s(m_L,s)}{f_s(m_H,s)} \), then \( \frac{1 - f(m_L,s)}{1 - f(m_H,s)} > \frac{f_s(m_L,s)}{f_s(m_H,s)} \). Thus, if \( \frac{\partial \eta_l}{\partial m} > 0 \), \( \frac{\partial \hat{\beta}_g}{\partial s} < 0 \).
Substitutes in Reliability

On the other hand, if \( \frac{\partial \eta_L}{\partial m} < 0 \), then \( \frac{\partial \hat{\beta}}{\partial s} \) may be equal to, greater than or less than zero.\(^{31}\) If machine and service qualities are substitutes in reliability, it is more likely that the posterior estimate of the probability of a high quality machine will be higher the lower is service quality.

In summary, if machine and service qualities are complements in reliability, then purchasing lower quality service will tend to lower the reputation of the machine where there is no breakdown and increase it where there is a breakdown. If machine and service qualities are substitutes in reliability, on the other hand, then the reputation of the machine will be better the lower the quality of service used where there is no breakdown, and may be worse the lower the quality of service where there is a breakdown.

(iv) Establishing the Net Effect on Expected Profits

The preceding analysis established conflicting effects for reputation from lower quality service depending on technology in the separate events of a breakdown or not. It might be ventured that the different effects on estimated probabilities of high quality where there is and is not a breakdown will tend to cancel each other out in calculating the \textit{ex ante} impact, \( \frac{\partial \Pi}{\partial s} \): “if higher service quality increases estimates of machine quality when there is no breakdown, it

\(^{31}\) Recall that if \( \frac{\partial \eta_L}{\partial m} < 0 \), then \( \frac{f(m_L, s)}{f(m_H, s)} < \frac{f_s(m_L, s)}{f_s(m_H, s)} \). Recall further that \( \frac{\partial \hat{\beta}}{\partial s} > 0 \) if and only if

\[ \frac{1 - f(m_L, s)}{1 - f(m_H, s)} < \frac{f_s(m_L, s)}{f_s(m_H, s)} \] 

But

\[ \frac{1 - f(m_L, s)}{1 - f(m_H, s)} > \frac{f(m_L, s)}{f(m_H, s)} \] 

so even if \( \frac{\partial \eta_L}{\partial m} < 0 \), \( \frac{1 - f(m_L, s)}{1 - f(m_H, s)} \)
must have an opposite effect when there is a breakdown, resulting in no net gain or loss to the machine manufacturer through the effect of changing service quality on customers’ estimate of machine quality.” After all, the average of the posterior estimates of the probability of a high quality machine should equal the prior estimate if that prior estimate is unbiased. But there are two flaws in this reasoning.

First, even if the effects of changing $s$ on $\hat{\beta}$ were to cancel each other out, the machine seller’s payoffs may differ depending on the effect $\hat{\beta}$ has on profit. That is, $\frac{\partial \pi}{\partial \hat{\beta}_{NB}}$ may be greater or less than $\frac{\partial \pi}{\partial \hat{\beta}_B}$. More cannot be said about the effects along this dimension without specifying the profit function, $\pi(\hat{\beta})$.

Second, changing service quality will have an impact on profits even setting aside the effect of the payoff function, $\pi(\hat{\beta}_i)$, because the customer updates its estimate of $\hat{\beta}$ using its prior belief about the probability of high quality, $\beta$, but the actual probability of high quality is 1 (since I am testing the hypothesis that a high quality machine manufacturer will need tying to protect its reputation). To illustrate this effect, assume that overall profits are linear in the realized estimated probability that the machine is high quality. That is, let $\frac{\partial \pi}{\partial \hat{\beta}_B} = \frac{\partial \pi}{\partial \hat{\beta}_{NB}} = k$, where $k$ is a constant, which implies that differences in the profit function do not account for the effect of changing service quality on overall expected profits. I will adopt the normalization $k = 1$ and thus $\pi(\hat{\beta}_i) = \hat{\beta}_i$.
The machine seller in this case will seek to maximize customers’ expected estimate of the probability that the machine is of high quality. Expected profit in this linear case is,
\[ \Pi = f(m_H, s)\hat{\beta}_{NB} + (1 - f(m_H, s))\hat{\beta}_B. \]

Differentiating with respect to service quality gives,
\[ \frac{\partial \Pi}{\partial s} = \frac{\partial \hat{\beta}_{NB}}{\partial s} f(m_H, s) + \frac{\partial \hat{\beta}_B}{\partial s} (1 - f(m_H, s)) + f_s(m_H, s)(\hat{\beta}_{NB} - \hat{\beta}_B). \]

Since profit is a linear function, the only reason why the average posterior estimate of the probability of a high quality machine, which is \( \Pi \) in this linear case, will be affected by changing service quality is that customers misapprehend the probability of a high quality machine when there is a high quality machine. That is, if the probability of a high quality machine were in reality \( \beta \) rather than 1, then \( \frac{\partial \Pi}{\partial s} \) would equal 0.\(^{32}\) Put another way, if the customer accurately predicted the probability of a high quality machine, the average of the posterior estimates of \( \hat{\beta}_i \) would simply equal \( \beta \); the negative effect when there is a breakdown would cancel out the positive effects when there is no breakdown. But the average of the posterior estimates of \( \hat{\beta}_i \) will not equal \( \beta \) because the customers underestimate the quality of the machine.

\(^{32}\) If the probability that the machine is high quality were \( \beta \), then expected profits would be,
\[ \Pi = [f(m_H, s)\beta + f(m_L, s)(1 - \beta)]\hat{\beta}_{NB} + [(1 - f(m_H, s))\beta + (1 - f(m_L, s))(1 - \beta)]\hat{\beta}_B. \]

Recall that \( \hat{\beta}_{NB} = \frac{f(m_H, s)\beta}{f(m_H, s)\beta + f(m_L, s)(1 - \beta)} \) and that \( \hat{\beta}_B = \frac{(1 - f(m_H, s))\beta}{(1 - f(m_H, s))\beta + (1 - f(m_L, s))(1 - \beta)}. \) This implies that, \( \Pi = f(m_H, s)\beta + (1 - f(m_H, s))\beta = \beta. \) Therefore, \( \frac{\partial \Pi}{\partial s} = 0. \)
Since the probability of a high quality machine in fact is 1, not \( \beta \), \( \frac{\partial \Pi}{\partial s} \) may be greater than or less than zero. The (rational) misperception of machine quality will have different effects on \( \frac{\partial \Pi}{\partial s} \) depending on whether machine and service qualities are complements or substitutes in reliability.

Since customers underestimate the machine’s quality on a probabilistic basis, there will be no breakdown more often than customers would predict. This in turn implies that, for linear profit, the effect of changing \( s \) on profit where there is no breakdown, \( \frac{\partial \pi}{\partial \hat{\beta}_{NB}} \frac{\partial \hat{\beta}_{NB}}{\partial s} \), will have a greater impact on expected profit than the effect of changing \( s \) on profit where there is a breakdown. This in turn means that the distinction between complements and substitutes in reliability has implications for the “bottom line” question of whether lowering \( s \) actually increases expected profits for the machine seller.

**Complements in Reliability**

If machine and service qualities are complements in reliability, that is, if \( \frac{\partial n_L}{\partial m} > 0 \), then

\[
\frac{\partial \hat{\beta}_{NB}}{\partial s} > 0, \quad \text{but} \quad \frac{\partial \hat{\beta}_B}{\partial s} < 0.
\]

Since \( \frac{\partial \hat{\beta}_{NB}}{\partial s} \) has a greater impact on overall profit than \( \frac{\partial \hat{\beta}_B}{\partial s} \) where profits are linear in \( \hat{\beta}_i \), the fact that customers underestimate machine quality tends to increase \( \frac{\partial \Pi}{\partial s} \) in the case of complements in reliability. Moreover, the fact that customers underestimate machine quality also affects the term in \( \frac{\partial \Pi}{\partial s} \) that does not involve \( \frac{\partial \hat{\beta}_i}{\partial s} \), namely

\[
f_{s}(m_H, s)(\pi(\hat{\beta}_{NB}) - \pi(\hat{\beta}_B)).
\]

Since customers underestimate machine quality, this latter term
may be greater or less than what customers would predict. It can be shown that if machine and service qualities are complements in reliability, then this term will be greater than customers expect.\textsuperscript{33}

Since increasing service quality increases both $\frac{\partial \hat{\beta}_{NB}}{\partial s}$ and $f_s(m_H,s)(\pi(\hat{\beta}_{NB}) - \pi(\hat{\beta}_B))$ where machine and service qualities are complements in reliability, the implications of $\frac{\partial \eta_L}{\partial m} > 0$ for $\frac{\partial \Pi}{\partial s}$ are unambiguous in the linear case: increasing service quality will increase expected profits, given that customers underestimate the probability of a high quality machine. If profits are a linear function of the expected estimated probability of high quality, and if machine and service qualities are complements in reliability, then this is sufficient to conclude that $\frac{\partial \Pi}{\partial s} > 0$.

In this case of complements in reliability, a customer knowingly purchasing lower quality service will harm the machine seller and tying may be a response to the confusion externality.

To reiterate the intuition behind the importance of complementarity, recall that presupposing a high quality machine in fact, customers’ estimate of the probability of no breakdown is too low. This implies that in the event of no breakdown the impact of customers’ estimates of high machine quality will, other things equal, tend to be disproportionately important to the effect that lowering service quality has on profit. Where machine and service qualities are complements in reliability, then lowering service quality will lower the estimated

\textsuperscript{33} This is because underestimation of machine quality will increase $f_s(m_H,s)$ relative to the customers’ estimate of this term if the cross-partial derivative, $f_{sm}(m_I,s)$ is positive. If $\frac{\partial \eta_L}{\partial m} > 0$, then it must be that $f_{sm}(m_I,s) > 0$. This is because if $\frac{\partial \eta_L}{\partial m} > 0$, then $f_{sm}(m_I,s)f(m_I,s) - f_{m}(m_I,s)f_s(m_I,s) > 0$. This is only true if $f_{sm}(m_I,s) > 0$. 
probability of the machine being of high quality when there is no breakdown. Since this effect where there is no breakdown is more important than the effect where there is a breakdown, purchasing low quality service will tend to lower expected profit.

Substitutes in Reliability

On the other hand, where machine and service qualities are substitutes in reliability, that is, \[ \frac{\partial \eta_L}{\partial m} < 0, \] then \[ \frac{\partial \beta_{NB}^*}{\partial s} < 0 \] and \[ \frac{\partial \beta_B}{\partial s} \] may be equal to, greater than, or less than zero. Since customers underestimate the probability of no breakdown, the no breakdown case is relatively more important in determining overall profits. Thus, when \[ \frac{\partial \eta_L}{\partial m} < 0, \] it is more likely that \[ \frac{\partial \Pi}{\partial s} < 0. \] However, machine and service qualities being substitutes in reliability does not necessarily imply that third term in \[ \frac{\partial \Pi}{\partial s}, f_s(m_H,s)(\hat{\beta}_{NB} - \hat{\beta}_B), \] is smaller than customers predict; this effect is ambiguous.\(^{34}\) While it is a necessary condition for \[ \frac{\partial \Pi}{\partial s} < 0 \] in the linear case that machine and service qualities be substitutes in reliability, it is not sufficient. Where profits are a linear function of the realized estimates of the probability that the machine is of high quality, all that can be said is that if machine and service qualities are substitutes in reliability, it is more likely that \[ \frac{\partial \Pi}{\partial s} < 0. \] If this condition is satisfied, the decision by the customer knowingly to purchase lower quality service will increase the machine seller’s profits on average. Tying does not respond to a confusion externality in this case.

\(^{34}\) If \( \frac{\partial \eta_L}{\partial m} < 0 \) then \( f_{sm}(m_i,s) \) could be greater than, less than or equal to zero.
The intuition for this result is that where machine and service qualities are substitutes in reliability, then purchasing lower service quality will increase estimates of machine quality where there is no breakdown. Since the no-breakdown effect is more important than the breakdown effect to overall profit (since customers who do not know that the machine is of high quality underestimate the probability of no breakdown), where machine and service qualities are substitutes in reliability, it is more likely that purchasing lower quality service will increase expected profit.

**General Implications**

As a general matter, the distinction between complements and substitutes in reliability is not dispositive in determining whether there is a negative or a positive externality on the machine seller from the buyer’s decision to purchase inferior service. In the case of linear profits, complementarity is sufficient to conclude that expected profits will fall when inferior service is used in conjunction with the machine, while substitutability is necessary but not sufficient to conclude that expected profits will rise when inferior service is used. But in the general case, the overall effect on profit of changing service quality, \( \frac{\partial \Pi}{\partial s} \), depends also on the effect of changing service quality on profits realized when there is no breakdown, \( \frac{\partial \pi}{\partial \beta_{NB}} \), and the profits realized where there is a breakdown, \( \frac{\partial \pi}{\partial \beta_{B}} \). Nevertheless, this analysis is useful in isolating the factors that affect \( \frac{\partial \Pi}{\partial s} \), particularly whether machine and service are complements or substitutes in reliability. The analysis demonstrates that where machine and service are substitutes in reliability, it is more likely that the customer’s decision to purchase predictably
lower quality service will leave the machine seller better off. In such a case, the confusion externality cannot explain tying. This possibility has not been appreciated in the literature.

(v) Two Examples

Two examples of the technological relationships between service and machine quality help illustrate the analysis. Using an intuitively appealing technological relationship, I present an example (Example I) where profits are linear in posterior estimates of quality, where machine and service qualities are substitutes in reliability and where purchasing lower quality service will always increase the machine seller’s expected profits. The example demonstrates that the possibility of higher expected profits from lower quality service is not implausible.

Consider the following examples of production functions. Example I is defined where

\[ f^I(m,s) = 1 - (1 - m)(1 - s). \]

This can be interpreted as indicating that both a machine failing and a service failing are necessary for a breakdown and \( m \) (0 < \( m \) < 1) and \( s \) (0 < \( s \) < 1) are the probabilities respectively of the machine and service not failing. Example II has \( f^{II}(m,s) = ms \).

This can be interpreted as implying that either a machine failing or a service failing is sufficient to cause a breakdown. In both examples, profits are linear; for simplicity, assume that

\[ \hat{\pi}(\hat{\beta}_i) = \hat{\beta}_i. \]

Example I involves substitutes in reliability: \( \frac{\partial \eta_L}{\partial m} < 0. \)

At the extreme, where there is no probability of a machine failing (\( m_H = 1 \)), even the lowest quality service (\( m_s = 0 \)) would not result in a breakdown. This means that it is more likely that \( \frac{\partial \Pi}{\partial s} < 0 \). Indeed, when profits are

\[ \eta_L = \frac{1 - m_L}{s + m_L(1 - s)}, \text{ so } \frac{\partial \eta_L}{\partial m} < 0. \]

\( ^{35} \)
linear and technology resembles Example I, it is the case that \( \frac{\partial \Pi}{\partial s} < 0 \). Expected profit in

Example I is,

\[
\Pi^I = \frac{(1-m_H)^2(1-s)\beta}{(1-m_H)\beta + (1-m_L)(1-\beta)} + \frac{(1-(1-m_H)(1-s))^2\beta}{(1-(1-m_H)(1-s))\beta + (1-(1-m_L)(1-s))(1-\beta)}.
\]

Taking the derivative with respect to service quality gives,

\[
\frac{\partial \Pi^I}{\partial s} = \frac{-\beta(1-\beta)^2 \{(1-m_H)(1-(1-m_L)(1-s))-(1-m_L)(1-(1-m_H)(1-s))\}^2}{\{(1-m_H)\beta + (1-m_L)(1-\beta)\} \{(1-(1-m_H)(1-s))\beta + (1-(1-m_L)(1-s))(1-\beta)\}^2} < 0.
\]

In Example I, the decision by a customer to purchase low quality service will on average enhance the machine seller’s profits and tying does not respond to a confusion externality.

Example II, on the other hand, leads to the opposite conclusion. In this case, machine and service qualities are neither complements nor substitutes in reliability: \( \frac{\partial \eta_L}{\partial m} = 0 \).\(^{36}\)

However, it is nevertheless the case that \( \frac{\partial \Pi}{\partial m} > 0 \). In Example II, expected profits are,

\[
\Pi^H = \frac{(1-m_H,s)^2 \beta}{(1-m_H,s)\beta + (1-m_L,s)(1-\beta)} + \frac{m_H^2\beta}{m_H\beta + m_L(1-\beta)}.
\]

This implies the following derivative:

\[
\frac{\partial \Pi^H}{\partial s} = \frac{\beta(1-\beta)^2 \{m_H(1-m_L,s)-m_L(1-m_H,s)\}^2}{\{m_H\beta + m_L(1-\beta)\} \{m_H(1-m_L,s)\beta + (1-m_L)(1-\beta)\}^2} > 0.
\]

\(^{36}\) \( \eta_L = \frac{m_L,s}{m_L,s} = 1 \) so \( \frac{\partial \eta_L}{\partial m} = 0 \).
Since \( \frac{\partial \Pi''}{\partial s} > 0 \), lowering \( s \) will lower the expected quality of the machine. In this case, the knowing decision to purchase low quality service hurts the machine seller on average and tying could respond to the confusion externality.

(vi) Conclusion on Stochastic Case

Analysis of the stochastic case provides a limited explanation of tying to protect reputation for quality. If customers are homogeneous in their preference for high quality machines and service, there is generally no need to tie since customers will purchase both from the machine manufacturer. Moreover, even if customers are heterogeneous such that some prefer to buy low quality service, there may not be a reason to tie. If machine and service qualities are substitutes in reliability, then it is more likely that the positive reputational effects on profits from satisfactory operation of the machine and service package even with inferior service dominate the negative effects from breakdowns. A positive externality from the buyer’s decision to buy low quality service is more likely. Indeed, if profits are linear and the technological interaction between machine and service quality resembles Example I, a tie is unnecessary to protect reputation.

On the other hand, there will be circumstances where the decision by a customer to purchase low quality service does predictably harm the machine seller’s reputation and expected profits. This is more likely if machine and service qualities are complements in reliability. In such cases, tying may address a confusion externality.

This explanation for tying is clearly more limited than is recognized in the literature described above. On the other hand, it is more expansive than the rare commentary that rejects
the reputation for quality protection explanation of tying. In discussing the *Kodak* case[^37], in which Kodak effectively tied service to its machines, Klein states that:

> While it is true that Kodak may have wanted to avoid being blamed for a breakdown ‘when the problem is the result of improper diagnosis, maintenance or repair by an [independent service operator],’ why not leave the choice of whether to rely on a single vendor or not up to buyers? Paternalism is a weak economic rationale for outlawing any business practice… [Citation omitted.][^38]

While the last sentence is confusing[^39], it appears that Klein concludes that paternalism should not provide the basis for tying. This, however, fails to recognize that there is an externality between buyer and seller: the buyer does not account for the seller’s reputation when purchasing inferior tied goods. While this externality may have limited importance because of a relatively deterministic relationship between quality and performance, because of homogeneous customers or because purchasing lower quality service actually enhances expected profits, in some other subset of cases the tie may efficiently internalize an externality. Klein’s position fails to account for the potential effect of heterogeneous customers, some of whom are relatively indifferent to high quality, and their failure to internalize reputational costs that may result when buying inferior service. It is simplistic to reject the confusion externality outright.

3. THE COST-SHARING EXTERNALITY EXPLANATION OF TYING

Circumstances will often arise in which there is an externality that may explain a tie based on quality control, but the externality need not be directly related to buyer confusion.

Where the costs of inferior performance of the tying/tied good package are not borne entirely by

[^37]: *Kodak*, *infra*.
[^39]: I assume in the last sentence that Klein is referring to Kodak effectively “outlawing” independent service providers on the basis of paternalism by refusing to supply them with parts, rather than antitrust law “outlawing” tying on the basis of paternalism. That is, the sentence might read, “Paternalism is a weak economic rationale for tying…”
the purchaser of the tied good, but rather are shared with the seller of the tying good, it may be optimal for the seller to impose a tie. Moreover, it may be optimal for the buyer to commit to purchase the seller’s high quality tied goods, otherwise the price of the tying good would increase.

The following conditions are required for a cost-sharing externality to explain tying. The tying and tied goods are used in conjunction with one another and the quality of the tying and tied goods affects the performance of the tying-tied good package. The seller of the tying good bears at least part of the costs of the performance of the tying-tied good package. For example, the tying good seller may offer a guarantee of the performance of the tying good, which performance is affected by the tied good. I will examine other possibilities in discussing the case law below. The buyer of the tying good has discretion (in the absence of a tie) over which tied goods to purchase for use in conjunction with the tying good. Because the quality of the tied good affects the performance of the tying-tied good package, and because the seller of the tying good has agreed to share the costs of performance, the choice of low quality tied goods allows the buyer of the tying good to impose costs on the seller. Because of this externality, the buyer may purchase sub-optimal quality tied goods from independent providers (who, because they do not internalize the reputational or other costs of low quality performance of the tying-tied good package, have less incentive to provide high quality). Anticipating this behavior, the tying good supplier will charge a higher price for its agreement to bear part of the costs of the tying good’s performance. Because the higher price results from an inefficient choice of low quality tied goods, it may be preferable for the buyer to commit to purchase only high quality tied goods. Tying may provide one such commitment device: the tying good buyer commits to purchase only high quality tied goods from the tying good seller. Of course, if the seller bears only a part of the
cost of the inferior performance, it may have inefficient incentives to provide inferior tied goods. However, it will also have its reputation as a tying good seller as a bond to help it commit to provide high quality. Tying may address the cost-sharing externality.

The cost-sharing externality is not based on the inability of purchasers of the tying/tied good package to distinguish between high and low quality tied goods either \textit{ex ante} or \textit{ex post}, as the standard explanation of the confusion externality in the tying context contends. Rather, it is based on the incentives that arise when the purchaser can share the costs of its knowingly purchased inferior tied goods with the seller of the tying good. Even if the use of the inferior tied goods results in poor performance that can clearly be attributed to the inferior tied goods, not the tying good, the tying good seller may prefer a tie in order to avoid sharing the direct costs of poor performance. The buyer may agree in order to commit not to impose inefficiently high costs on the seller.

To illustrate the point, suppose in the above example where quality determines performance that the contract between the seller and buyer of the machine divides the costs of the machine’s performance between the buyer and the seller. For example, suppose the machine seller guarantees performance and promises to refund part of the purchase price in the event of poor performance; the seller therefore finds downtime costly. The buyer also suffers to some extent from downtime, but may rely on the guarantee to limit its costs. Suppose that the costs are as follows:

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Assume, as before, that the cost of high quality service is 40, while the cost of low quality service is 10. While high quality service costs 40, it brings collective benefits (by reducing costs) of 50, but only brings private benefits of 25 to the machine user, thus it will have an incentive to purchase low quality service from an outside supplier. In the absence of a tie, the machine seller will anticipate the extra costs associated with the cost-sharing externality and the price of the machine with a guarantee of performance will rise by the expected extra costs of low quality servicing. Since the use of inferior service brings collective costs that outweigh the collective benefits, both parties would be better off (assuming the optimality of the cost-sharing arrangement) if the user of the machine could commit to purchasing high quality service. One way of achieving this commitment is through a tie: the user of the machine commits through the tie to purchase high quality service, while the seller commits through a concern for its reputation, and through its sharing of the costs of the machine’s performance, to provide high quality service.

Therefore, where there is an externality between the buyer and seller of a tying good, in that the seller bears some of the cost of the tying good’s sub-par performance, it may be that a tie will serve to help the buyer commit to purchasing high quality tied goods, which brings an ex ante benefit both to buyer and seller. In the next section, I analyze some leading U.S. tying cases to provide a context for the theory in Sections 2 and 3.

4. THE CASE LAW

I have shown that the confusion externality and the cost-sharing externality may apply, but in limited circumstances. Most commentators have failed to account for buyer rationality and thus have not focused on the central problem that arises with the confusion externality: the possible externality between buyer and seller when the buyer purchases low quality tied goods,
not the externality between tying good seller and independent tied good sellers. Interestingly, the courts have tended to reach reasonable results when confronted with quality-control explanations of tying. Their reasoning, however, is sometimes lacking. There are two classes of case: where the courts reject the quality-control argument; and where they accept them.

Where the courts have rejected the quality-control argument, they have often relied on the availability of substitutes to tying. For example, rather than tying to ensure high quality tied goods, the tying good supplier could simply set certain quality standards for tied goods.\(^{40}\) Aside from Bork’s observation about increased policing costs if standards are set,\(^{41}\) more fundamentally the argument fails to account for buyer rationality: buyers seeking high quality will recognize the attenuated incentives of independents to provide high quality. Tying or its substitutes is only necessary if there is a negative externality from the buyer’s choice of low quality service. As the analysis has shown, this negative externality will often not exist.

But courts have not exclusively relied on the existence of substitutes to reject the quality-control explanation of tying. Sometimes they point to particular factual issues that render tying unnecessary as a quality-control device. For example, Kodak\(^{42}\) involved the alleged tying by Kodak of service to its photocopy machines, a tie accomplished by its refusal to supply proprietary parts to Independent Service Operators (ISOs). Kodak attempted to justify the alleged tie on the basis of the confusion externality, arguing that they were concerned about being “blamed for an equipment malfunction, even if the problem is the result of improper diagnosis, maintenance or repair by an ISO.”\(^{43}\) The Supreme Court rejected the argument, noting

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\(^{40}\) See, e.g., Standard Oil, supra at 1058; International Salt Co. v. United States 332 U.S. 392 (1947).

\(^{41}\) See Bork, supra.


\(^{43}\) Kodak’s brief, quoted in Kodak, supra at 483.
that evidence was proffered that some customers preferred the service of ISOs to Kodak’s.\textsuperscript{44}

Whether the quality of ISO service was better than that of Kodak in fact is not particularly important, notwithstanding the Court’s emphasis on the high quality of ISOs’ service. What is potentially crucial, however, is that customers apparently could distinguish the quality of service. If this was so, the goodwill explanation of the tie is implausible. Bad performance of the machine could be attributed to bad service. Those customers seeking high quality service could purchase it from ISOs with a reputation for quality.

In other cases where the Court rejects the quality-control explanation of tying without offering explicitly a compelling reason for doing so, the factual background is such that the explanation is implausible. \textit{International Salt}, for example, involved the tying of salt to the lease of machines that dissolved salt into brine and injected salt into canned goods during the canning process. Kaplow reports that International Salt raised the protection of goodwill argument in its brief.\textsuperscript{45} Moreover, the Supreme Court described International Salt as concerned about minimizing its cost of maintaining the machines, which raises a possible cost-sharing externality.\textsuperscript{46} The problem with both these explanations is that, as Peterman reports, there was no evidence in the record of the harm that arose from the use of inferior salt.\textsuperscript{47} Consequently, there was no evidence that customers would blame International Salt for inferior performance

\begin{itemize}
    \item \textsuperscript{44} \textit{Kodak}, \textit{supra} at 483.
    \item \textsuperscript{45} Kaplow, \textit{supra} at note 121.
    \item \textsuperscript{46} \textit{International Salt}, \textit{supra} at 397. There is some ambiguity in the opinion as to who was responsible for maintenance during the course of the lease. The Court at note 5 reproduced a clause in the lease which vested responsibility for maintenance and repair with the lessee, yet appeared to accept International Salt’s claim that there was a reason to minimize its costs of maintaining the machines under the contract. Perhaps Peterman clears up the matter by noting that International Salt “guaranteed” the Lixator over the course of the lease, which may imply that it was responsible for significant breakdowns, while the lessee was responsible for regular maintenance: J. Peterman, “The International Salt Case” (1979) 22 J. Law & Econ. 351 at 352.
    \item \textsuperscript{47} Peterman, \textit{supra} at 360.
\end{itemize}
from inferior salt or could impose costs on it by purchasing low quality salt. Without this evidence, there was no basis for accepting a quality-control explanation of tying. While the Court failed to canvass these factors and instead relied only on the availability of substitutes to tying, it reached a reasonable result on the facts.

As *International Salt* illustrates, courts on occasion have failed to articulate a compelling reason for rejecting the quality-control explanations of tying, but this does not imply their failure to decide the case in a plausibly correct way. Similar analysis applies where courts have accepted the quality-control claims of tying good suppliers. In particular, while courts appear to have reached justifiable results, their reasoning is sometimes unsatisfactory. For example, courts have failed clearly to distinguish the confusion externality and the cost-sharing externality. Yet the distinction could have important legal significance. The following detailed analysis of two cases, *Jerrold Electronics*\(^{48}\) and *Pick*\(^{49}\) illustrates the potential significance of the distinction between externalities, as well providing two examples of how tying good sellers may share the costs of performance of the tying-tied good package with buyers.

(i) *United States v. Jerrold Electronics*

*Jerrold Electronics* is generally held out as the leading case confirming the possibility of justifying a tie on the basis of the confusion externality.\(^{50}\) The case involved the installation and maintenance of community television antennae in the early 1950s. Jerrold imposed certain tying conditions on buyers of community antennae. First, it would not sell antennae without also selling a full service contract; the government alleged that this was an unreasonable restraint of

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\(^{49}\) *Pick Mfg. Co. v. General Motors Corp.* 80 F.2d 641 (7th Cir. 1935).

trade pursuant to s. 1 of the Sherman Act. Second, it would require purchasers to buy Jerrold equipment for use with the antenna; the government alleged that this infringed s. 3 of the Clayton Act’s prohibition of tying the sale of goods to the sale of other goods.

The confusion externality was cited by the court as a justification for the service tying arrangement. Since Jerrold was introducing a new product, “interest would wane rapidly if the systems installed did not consistently produce satisfactory results.”

Jerrold had found with some of its other equipment that outside service providers tended to offer inferior service. Thus, in order to protect its reputation, Jerrold imposed the tie of antennae to service contracts. The Court held that the tie was justified, at least for the years during which Jerrold was introducing the product.

A response to this explanation of the tie is found in the court’s opinion, where it observed, “It has been suggested that Jerrold could have accomplished the same results by addressing the persuasive argument it made to this court to its customers and leaving use of the contracts on a voluntary basis.” Customers would have recognized that the service provider with the strongest incentives to provide high quality service was Jerrold because of its concern about its reputation as a provider of the antenna-service package. Following reasoning that tracks closely the analysis of case where quality and performance are only stochastically related, the Court rejected this contention, stating that, “This argument assumes that Jerrold and the industry could survive ‘transitory disloyalties’ this approach would entail.”

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51 Jerrold Electronics, supra at 556.
52 Id. at 557.
53 Id.
Why would Jerrold not have survived “transitory disloyalties”? An important observation is that buyers would recognize that Jerrold had stronger incentives to provide high quality service. Any customer obtaining service from a provider other than Jerrold would have accounted for this relative lack of incentive to provide high quality service in assessing the antenna’s performance. Moreover, outside observers would want to know the source of the servicing before reaching conclusions about the quality of the antenna.

However, if some customers were willing to purchase knowingly low quality service from independent providers, then there may have been a confusion externality: it may have been that the expected profits of Jerrold were lower following the use of inferior tied goods, yet the buyers did not account for this negative externality when purchasing tied goods. Given the novelty of the product, it may well have been appropriate to conclude that an individual antenna’s performance would have a significant effect on the prior probability of high quality held by observers, and in turn profits. There was not a large number of potential observations to draw upon to limit uncertainty.\(^{54}\) The Court implicitly recognized this by asking, rhetorically, whether the firm could have survived “transitory disloyalties”; put another way, individuals’ experiences would have had a significant impact on the prior probability of high quality held by observers and thus on Jerrold’s profits.

\(^{54}\) Even if there are a large number of potential observations because of a large customer base, as in International Salt or Kodak, it is necessary to inquire into whether customers or potential customers will be able to learn from a broad range of experiences. It may be that even with a large customer base, potential customers only learn about quality from observing a small sample. On the other hand, where there is a large sample from which to learn cost-effectively about quality, the situation will more closely resemble the determinate case even if technology is stochastic; the large sample will remove much of the randomness in the relationship between quality and performance. In Jerrold, as the Court points out, the small customer base ensured that potential customers would have a very small sample from which to assess quality.
Even in this case with a small number of customers, it is not necessarily the case that there is a negative confusion externality that a tie would address. As discussed, buying inferior service can be expected to *enhance* the reputation of the machine. In fact, Jerrold had adopted this policy in response to its early experience with the technology. It found several instances where its equipment had been used by independent operators “with unsatisfactory results.”\(^\text{55}\) Tying to protect Jerrold’s reputation from customers buying inferior service may have been plausible in this case.\(^\text{56}\)

While the goodwill explanation may have applied, there were allusions to another externality that seems relevant to the tie. The Court noted that,

> In addition to its reputation, Jerrold was also dependent on successful system operation for payment. Many operators were not in a position to pay cash for the necessary equipment and the costs were such that outside financing could not be obtained. Therefore, payment was often contingent on the success of the system.\(^\text{57}\)

An antenna operator who purchased lesser quality service from outsiders would not bear the full costs of its choice. If the antenna failed to operate properly, it would apparently not be compelled to pay Jerrold. While having Jerrold bear the cost of the antenna’s failure may have been an efficient allocation of risk, it may have created perverse incentives for the antenna operator to purchase shoddy, but inexpensive, service.\(^\text{58}\) If the inexpensive service worked, the operator would have realized the benefit of the antenna while paying less for service. If it did

\(^{55}\) *Id.* at 500–51.

\(^{56}\) It is apparent that improving the service from inferior independents’ service to Jerrold’s own service led to a much greater likelihood of the package’s successful operation. Assuming high quality Jerrold antennae given Jerrold’s eventual success, this (although far from conclusive) may have implied that antenna and service quality were complements in reliability. Where tying and tied goods’ qualities are complements in reliability, it is more likely (though not determinative) that inferior tied goods will lower tying good seller’s expected profits.

\(^{57}\) *Id.* at 556.

\(^{58}\) Jerrold’s service was apparently more expensive than outsiders’: see *id.* at 557: “Jerrold’s service was costly…”
not, the operator did not have to pay Jerrold. The tie may therefore have addressed the perverse incentive to buy inferior service resulting from a cost-sharing externality.

Jerrold ceased to impose the tie after a number of years. The Court took this to be evidence that once the product was established, the tying was no longer necessary to protect Jerrold’s reputation. This may well have been so. It may also have been true that once the antennae were operating successfully, it was no longer excessively costly for operators to obtain outside financing. Consequently, it may have been that payment was no longer contingent on the antenna’s operation, and thus it may no longer have been necessary for Jerrold to tie service given that it no longer shared the cost of low-quality service. There is no evidence in the court’s opinion, however, about whether Jerrold ceased to bear the cost of the antenna’s failure.

With respect to the tie of Jerrold equipment to a purchase of a Jerrold antenna, the Court observed that the tie was “intimately associated with [Jerrold’s] belief that a service contract was essential.”59 As the Court suggests, if this belief was justified because of the confusion externality, the equipment tie was justified for similar reasons. Moreover, the cost-sharing externality was relevant to the equipment tie. If there was a reason to tie service because the costs of inferior service were borne partially by Jerrold, there was also reason to tie equipment. First, to the extent that low quality equipment harmed the operation of the antenna, Jerrold may have partially borne the costs through its assumption of the cost of the antenna’s failure. Second, to the extent that low quality equipment simply drove up the cost of service (that is, high quality service was to some extent a substitute for high quality equipment), Jerrold may also have partially borne the costs of shoddy equipment because of its obligations under the service contract. The tie may have responded to these incentives to purchase inferior equipment.

59 Jerrold Electronics, supra at 560.
*Jerrold* provides an example of how both the confusion externality and the cost-sharing externality may have been plausible explanations of the tying arrangements. The Court, however, fails to distinguish clearly the different explanations, notwithstanding that they have different legal implications. For example, if the cost-sharing externality was sufficient to impose the tie, the time-limited allowance of tying by the Court may have been inappropriate. Even if Jerrold succeeded in establishing a well-known reputation for quality, thus rendering the confusion externality implausible, if it continued to guarantee the performance of the antennae, the tie may still have been useful in responding to a cost-sharing externality. While reaching a reasonable result, the Court could have clarified its reasons more precisely.

(ii) *Pick Mfg. Co. v. General Motors Corp.*

Before reviewing the *Pick* case in particular, it is helpful first to discuss Klein and Saft’s analysis of a family of cases in which tying plays a quality control role. These cases have nothing to do with the confusion externality, but provide a specific example of the cost-sharing externality. In franchise contracts, the franchisor often requires the franchisee to purchase goods only from it. For example, in *Chicken Delight*, as a condition of the franchise (the tying good), franchisees were required to purchase chicken containers (the tied good) from the franchisor. The concern motivating the tie may have been that the individual franchisee would share the costs of inferior tied goods with the franchisor because the individual’s customers would depreciate their view of the franchise name generally as the result of their experience with the inferior tied good. As Klein and Saft point out, this is not an irrational reaction by customers, rather they have more information about the quality control franchisors impose on franchisees as

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60 Klein and Saft, *supra*.

61 *Siegel v. Chicken Delight* 448 F.2d 43 (9th Cir. 1971).
a result of their experience with the shoddy tied goods.  

Free riding on the franchisor’s good name by individual franchisees seeking to save money by chiseling on quality may lead them to purchase inferior inputs.  

A tie responds to free-riding by franchisees. The franchisor imposes the tie to ensure that the franchisee does not chisel on quality. While it could specify quality and monitor to ensure that the franchisee complies, there remains an incentive for the franchisee to cheat. The tie reduces policing costs. Rather than determining whether the franchisee has purchased inferior quality tied goods, the franchisor simply needs to determine whether the franchisee has purchased tied goods from a supplier other than it. Such a commitment is best for both the franchisor and the franchisees ex ante by addressing the free-rider problem that plagues franchise arrangements. The franchise is worth more to both parties if they can commit to protecting its reputation.  

Such an analysis may apply to Pick. In that case, General Motors required its Chevrolet parts distributors and dealers as a condition of the supply contract not to sell parts not approved by Chevrolet. The Court concluded that the contract did not violate antitrust law. While ultimately concluding that the contracts failed to lessen competition substantially, the Court discussed the business justification for the tie in some detail. It noted that GM offered a 90 day or 4,000 mile express warranty and cited with approval the District Court’s conclusion that the requirement that dealers sell only GM parts was “entirely appropriate and legitimate in carrying 

\[62\] Klein and Saft, supra at 350-51.

Klein and Saft are skeptical that the tie in Chicken Delight itself responded to free-riding: the gains from inferior chicken buckets to the franchisees would have been minimal. They suggest that price discrimination more likely explained the tie in that case. The structure of the argument applies, however, whether or not it is plausible in the result.  

\[64\] In particular, it did not violate section 3 of the Clayton Act.
out the above mentioned warranties, policies or obligations of the manufacturer to customers…”\textsuperscript{65} The warranty raises a straightforward cost-sharing externality. If dealers offered low price, low quality parts to drivers, drivers would be more likely to purchase them given that General Motors bore a significant part of the cost of poor performance during the warranty period. Preventing dealers from selling these parts limited buyer opportunism in this respect. In addition, the warranties provided that the warranty would not apply to “any vehicle which shall have been repaired or altered so as, in the judgment of the manufacturers, to affect its stability and reliability.”\textsuperscript{66} This may have discouraged car-buyers from having their cars serviced by independents rather than GM dealers.

The Court considered whether it was legitimate for the restriction to prevent dealers from selling non-GM parts for use in cars that have outlived the warranty expiry date. The Court’s analysis provided a clear statement of the confusion externality:

But there are certain other material facts. Repairs will be made after the expiration of the 90-day period. They are necessitated by natural wear, tear, and breakage. In the minds of the owners, the cars are identified and associated with the manufacturer. If defective or inefficient repairs or replacements should be made, and the cars, as a result, should operate unsatisfactorily, the owners’ recollections will naturally and inevitably revert to the specific name and manufacturer thereof. Defective parts, preventing efficient operation of cars, bring dissatisfaction with the automobiles themselves. The natural result is blame of the manufacturer and consequent loss of sales.\textsuperscript{67}

The Court failed to consider, however, how the tie would resolve reputational concerns given that car owners were free to purchase inferior goods from non-Chevrolet dealers. If the tie was intended to respond to the confusion externality, it would be insufficient since customers relatively indifferent to quality may have purchased shoddy parts from independents. A better

\textsuperscript{65} \textit{Pick, supra} at 642.
\textsuperscript{66} \textit{Id.} at 642.
\textsuperscript{67} \textit{Id.} at 643.
description of the tie is that it responded to a cost-sharing externality resulting from the dealer network.

Car owners seeking high quality parts would buy parts and service from Chevrolet dealers precisely because of Chevrolet’s concern for its reputation for quality; a concern not shared by independent parts distributors and service providers. The buyer would rely on General Motors to ensure that its Chevrolet dealers would install appropriate parts in order to protect Chevrolet’s reputation. Ensuring that the dealers do actually provide high quality parts may have explained the tie. To develop this point, consider Bowman’s observation:

The substance of the court’s holding was that substandard parts installed in a General Motors car by a General Motors dealer would have a deleterious effect on the company’s good will because users would not ordinarily associate the improper functioning of their automobiles with the use of non-General Motors parts. Why the dealers’ interest in this problem should not parallel that of General Motors was not discussed in the case. An absence of conflict of interest at least would support a strong presumption that the difficulties arising from problems of technological interdependence between products can be resolved by means other than tying contracts.68

While Bowman in general is correct to question the purpose of the tie where there is no conflict of interest and he is also correct to point out that the Court failed to discuss the conflict in this case, there may well have existed such a conflict. Each dealer in the General Motors network would face temptation to exploit the reputation of Chevrolet for quality: the dealer would individually reap the benefit of providing low-cost, inferior parts, while the cost of sub-standard performance is shared by GM and the dealers through a drop in the network’s reputation for quality. This is another example of the cost-sharing externality: the cost of inferior parts is shared by the buyer (the dealer) and the seller (General Motors). In such a circumstance, the tie

68 Bowman, supra at 28.
may exist to allow the dealer to pre-commit not to buy inferior parts, leaving both parties better off *ex ante*.

The Court may have been justified in its result, although not in its reasoning, in the *Pick* case: it was a cost-sharing, not a confusion, externality that justified the tie.⁶⁹ Again, the legal implications of this distinction are significant. For example, if the confusion externality explanation were persuasive, this would not only justify a tying arrangement with dealers to use only high quality parts, but also on the ultimate car buyer. Since it was the cost-sharing externality that arose, the quality-control explanation only was applicable to the tying arrangement with dealers.

5. CONCLUSION

In this article I have discussed why the confusion externality, which arises because of confusion over whether faulty tying goods or tied goods caused inferior performance, is likely to explain tying in only a limited set of circumstances. There are two central reasons for this skepticism. First, where conditions exist that could lead to a possible confusion externality, such as the impossibility for most customers of determining *ex ante* or *ex post* the quality of the tying good alone and the importance of reputation to the tying good seller, customers seeking high quality performance will recognize that independent suppliers have a relatively weak incentive to provide high quality tied goods. These customers will purchase from the tying good seller even without a tying restriction. Second, even the purchase of low quality tied goods from independents by a customer who is relatively indifferent to quality may not impose a negative

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⁶⁹ For a similar case in which the free-riding concern was discussed in finding a tie justified, see *Mozart, supra*. 
externality on the tying good supplier. Customers will anticipate low quality tied goods from independents and will assess the tying good quality accordingly. This may imply harm to the manufacturer in some circumstances, since sometimes purchasing lower quality service can harm the tying good’s reputation and profits even though the parties know the low quality of service. But in other cases harm does not arise, since tying good quality can be directly inferred from performance, or there may even be a predictable boost to the manufacturer’s reputation and profits from the purchase of low quality service. This is because good performance with the observable purchase of inferior tied goods may result in a relatively large upgrade of outsiders’ perception of its quality and profits.

The confusion externality may apply in limited circumstances. The confusion externality seemed plausible in the Jerrold Electronics case. In that case, the product’s novelty and therefore fragile reputation implied that antenna purchasers who were relatively indifferent to quality may have imposed costs on Jerrold through their purchase of predictably inferior independent service, but did not account for this cost in making purchasing decisions. The tie may have addressed a negative externality imposed on the seller by the buyer.

A different type of externality may skew the incentives of tied good purchasers and justify a tie. Where the seller of the tying good bears some of the cost of the use of inferior tied goods in conjunction with the tying good, the buyer of the tying good may have an incentive knowingly to purchase the cheaper, inferior tied goods. For example, Jerrold was in part responsible for the antennae’s successful operation through its guarantee of performance. Consequently, users of the tying good would not bear the full costs of purchasing tied goods that adversely affected the operation of the tying good. Ex ante both parties are better off if they can commit to using only high quality tied goods. The tie accomplishes this. Similarly, the tie in
franchise contracts serves a control on quality, benefiting both the franchisor and franchisee, as the Pick case suggests.

The analysis suggests a law that treats the confusion externality justification with skepticism, but also a law that is sensitive to the cost-sharing externality justification. The analysis is largely consistent with the results of the cases examined here, although the courts sometimes fail to clarify their reasons satisfactorily. Most significantly, while the confusion and cost-sharing externalities are distinct, there is a tendency to elide them in the case law. This arises for two reasons. First, the cost-sharing externality in cases such as Pick relies on reputation. Rather than directly sharing the costs of inferior tied goods with the seller through higher costs of repair, for example, the buyer shares the cost of a harm to reputation with the seller because of the franchise arrangement. This is close to, but different from, the confusion externality. The buyer in the cost-sharing scenario (e.g., a dealer in Pick) intentionally purchases inferior goods and there need be no confusion about the effect of the inferior parts on the cars’ performance. The ultimate customers (the car owners) however, discount the reputation of the upstream supplier (General Motors) because of an eroded faith in the quality control arrangements in the distribution chain. A harm to a supplier arises even if there is no confusion about responsibility for the inferior performance.

A second reason for the tendency to elide the confusion and cost-sharing externalities is that the motivation to tie in order to address the cost-sharing problem may often arise where the confusion externality is alleged to arise. That is, parties may adopt cost-sharing arrangements in cases where there is poor information about the quality of the tying good. For example, the fact that the antenna technology in Jerrold was new implied that there was poor information about its

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70 See, in particular, Pick, supra.
usefulness. This novelty was influential in convincing the Court of the confusion externality. The novelty of the technology was also no doubt an important reason why Jerrold and customers agreed to make payment contingent on the antenna’s success. Once such payment was contingent on the antenna’s success, a compelling reason for the tie existed: to ensure that customers did not intentionally buy inferior tied goods in the knowledge that if the antenna failed, no payment was required.

While the two explanations for tying likely arise in similar circumstances, it is important for the law to be clear on which explanation is at issue in a given case. Acceptance of the confusion externality in the Pick case, for example, would appear to imply a justification for a tie that would restrict car buyers to buying only Chevrolet-approved parts. Reliance on the franchise cost-sharing externality, however, would restrict the tie to dealers only. While the cases reviewed in this article appear to reach sensible results on the explanation of tying as quality control, courts should articulate precedents that clarify more precisely their reasons.71

71 For an example of a well-articulated discussion of the cost-sharing externality, see Mozart, supra.
REFERENCES


Peterman, J., “The International Salt Case” (1979) 22 J. Law & Econ. 351-364.

