Why are Sales Law Remedies of Limited Duration?

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September 18, 2010

Abstract

In the sales law of most countries the duration of the buyer's claim for remedies is cut off by a statute of limitations. The present article argues that there is a rationale for cutting off the buyer's claim, and also determines the optimal length of the cut-off period. Essentially, allowing claims strengthens the seller's incentive to provide goods of durable quality, but may lead the parties to incur costs, e.g. for inspections, to resolve the validity of claims. With the passage of time after purchase, the incentive effect decreases, while the incentives for the parties to spend resources on resolving claims remains constant. The model derives a simple expression for the optimal cut-off period based on these forces, applies it to the question of whether the cut-off period should be shorter for used goods, and presents empirical evidence consistent with the theory.

1. Introduction

Sales law limits the period of time after sale during which the buyer can raise a claim. When the buyer is a firm, the law fixes a default period that applies whenever the parties have not stipulated a (warranty) period in their contract, whereas when the buyer is a consumer, the law fixes both a default period and a mandatory minimum period. The latter protects the consumer by not allowing the seller to offer warranties of shorter duration.[1]

Both the enabling and the mandatory rule has been the subject of controversy. Consumer advocates see no rationale for cutting off claims due to the mere passage of time, and maintain that it is unfair when the buyer can prove that the good was defective at the time of purchase. A Danish Committee report[2] supported this view, stating that:[3]

> 'abolishing or at least extending the default cut-off period is long overdue.'

On the other side of the debate, seller and producer organizations have argued against a lengthening of the cut-off period on the grounds that it would lead to higher costs of administering claims.

The question of the rationale of the cut-off period in sales law should be distinguished from that of the optimal duration of warranties, which has already been analyzed by Dybvig and Lutz [5], Cooper and Ross [4], and Emons [7], among others. Dybvig and Lutz and Cooper and Ross find a rationale for the limited duration of most warranties in the incentive it creates for buyers to be careful in using the good. However, this rationale supposes that the buyer can claim a remedy when her usage has caused the dysfunction, and while that is true when the warranty places the burden of proof concerning causation on the seller (unless the seller can prove that the good was not

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[1] The length of the period differs widely between countries and legal systems, e.g. it is two years in several EU countries, it is four years in the US (under the Uniform Commercial Code), and in Finland sales law sets no limit to when a claim can be made. The Norwegian rule sets the general cut-off period at two years, but extends the period to five years for goods that should, by normal use, last longer than two years. In Holland, the mandatory period equals the expected life time of the given good.

[2] Committee Report 1403/2001 (Betænkning 1403/2001), p. 146.

[3] For a similar view, see the Norwegian Committee Report NOU 1993:27, the Danish reports 1133/1988 (on services) and the Swedish report SOU 1995:11. The last advocates a default period of five years.

defective), it is not true under sales law, which puts the burden of proof on the buyer.[4] Hence, the literature on the optimal duration of warranties does not directly address the rationale for cutting off the buyer's claim under sales law.

The present paper argues that the optimal cut-off period under sales law balances the incentive for the seller to provide goods of durable quality with the cost of resolving claims, i.e. of resolving disputes concerning the rights of the parties under the sales contract. When the parties are unequally informed about the defectiveness of the good (e.g. because the buyer alone knows the circumstances under which the good has broken down), or if they hold different beliefs about when a good is legally defective, they may choose to incur claim resolution costs. For instance, they may agree to bring the matter before a legal tribunal, or they may spend resources to find the cause of the dysfunction. The model will emphasize the investigation costs but for some goods the cost of argument and litigation is more important, and the analysis would not be much different in that case.[5]

The longer the cut-off period the greater the incentive for the seller to invest in delivering a good of high durability, but also the higher the claim resolution costs. An optimal cut-off period emerges essentially because the incentive effect of cutting off claims diminishes over time due to the declining marginal productivity of investment in durability. Thus, if the cut-off period is very short, even very efficient investments in durability will not be undertaken (ignoring reputation effects and assuming that the buyer cannot observe durability at the time of purchase), whereas extending an already long cut-off period will induce marginal investment that at some point will not outweigh the cost of inspections.

The determination of optimal statutes of limitations (and statutes of repose[6]) as a trade-off between incentives and administrative costs has already been explored by Miceli [15][7] in the context of product liability. However, his theory finds the rationale for cutting off claims in the discounting by

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[4]Except in some countries for an initial period after purchase.

[5]Litigation costs are likely to involve significant externalities since the losing party usually does not compensate the other party for all costs. This strengthens the case for cutting off as the externality is likely to lead to higher costs of conflict resolution in equilibrium.

[6]In product liability, the statute of repose runs from when the good was sold while the statute of limitations (generally) runs from the time the accident occurred.

[7]See also Baker and Miceli [1] for an empirical analysis.

the injurer of future litigation costs, which shifts the trade-off between incentives and administrative costs over time. While this may be a salient factor in product liability cases, where many years can pass between sale and injury, and between incident and discovery of harm (as when a medical product causes harm several years after purchase and several years after use), it appears less relevant in the context of sales law where dysfunctions usually occur after a relatively short periode of time.

A different rationale for statutes of limitation is proposed by Landes and Posner [12], who emphasize that evidence and memory deteriorates over time. Since evidence deteriorates over time in many fields of law, this factor may be a candidate for a general theory of statutes of limitation, but in the context of sales law, deteriorating evidence does not seem to play a dominant role, since the issue of whether the good has met the buyer's reasonable expectations can often be answered through inspection of the good's current state. Note, however, that information concerning the buyer's reasonable expectations at the time of purchase, and about the state of the good at that time, might deteriorate. The argument made here is that this is not sufficiently typical to alone provide a rationale for the limitation period. The explanation of deteriorating evidence is, however, complementary to the one offered in this paper.

Palfrey and Romer [16] analyse the effect of alternative dispute resolution mechanisms in the context of sales, emphasizing the externality that arises when the buyer raises a claim that is costly to investigate.[8] They do not address the question of why time passed since purchase should be a relevant criterion for cutting off claims.

Martin [14] suggests that cutting off claims allows businesses (and consumers) to 'close their books', i.e. to dispose of old files. Again, however, this concern does not seem salient in the area of sales contracts, where specific details about the good typically are not needed to assess the cause of a dysfunction, and where it is the responsibility of the buyer to keep her proof of purchase. Moreover, it has been suggested that shifting the risk from seller to buyer might justify a cut-off period, but there is no explanation as to why the creditor (the buyer) bears the risk at a lower cost. Although there are sometimes many buyers to share the risk, it is often the case that the seller is a large firm, capable of bearing the risk. Still, like deteriorating evidence, the concern for optimal risk allocation may well complement the rationale

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[8]On this externality, see in general Shavell [18].

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offered in the present paper.

In the following, we first consider a model of the trade-off between the incentive effect and claim resolution costs, and then apply the model to the policy issue of whether a shorter cut-off period should apply to the sale of used goods than to the sale of newly produced goods, and to the advisability of the mandatory minimum period in consumer sales law. Some empirical evidence is then presented from a survey concerning the extension of the mandatory cut-off period in Denmark in 2002. The survey demonstrates that the cut-off period does have an effect on incentives and (more obviously) on the number of claims raised. The article ends with a discussion and a summary.

2. The Model

In brief outline, the lawmaker first sets the cut-off period after which the seller chooses effort that stochastically determines the durability of the good. Durability may be either high or low where low durability is assumed to be legally considered a defect. Not knowing the actual durability of the good (this is important for the later stage of conflict resolution), the seller offers it at a price which the buyer either accepts or rejects taking into account the seller's incentive to provide a durable good (an incentive affected by the cut-off period). The buyer then uses the good which gradually wears down, and at some point will become dysfunctional even if of high durability. If it becomes dysfunctional before that point, the buyer will know the circumstances of breakdown, and will hence know whether the good is defective. The seller will not know the circumstances and this asymmetry of information may lead to conflict resolution costs. The parties may spend resources to inspect the cause of the dysfunction where the outcome of the investigation determines who pays for both replacement (or repair) and for the cost of investigation. The analysis is simplified by assuming that the seller can commit to investigate the claim. If the seller commits, the buyer will only raise a warranted claim[9], which will then be investigated. When setting the cut-off period, the lawmaker must take into account the expected investigation/inspection costs as well as the effect of the cut-off period on the seller's incentives to deliver a good of efficient durability.

This sequence, the rules of the game and the notation is now introduced in more detail.

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[9]The more realistic case where the buyer will also sometimes raise unwarranted claims is discussed below.

The policy-maker first sets the cut-off period $\widetilde{T}$ with the aim of maximizing the sum of the pay-offs to the seller and the buyer. The seller then chooses how much to invest in the durability of a good. In short notation, the seller chooses the probability q, that the good produced will be of low $\phi = \phi_l$, rather than of high durability, $\phi = \phi_h$. The cost of the effort is $c(q)$. To avoid corner solutions, let $c'(q) < 0$, $c''(q) > 0$, and $c'(q) = 0$ when $q = 1$, and $c'(q) \to -\infty$ when $q \to 0$. The durability affects the probability of dysfunction during the product's life time $[0, T]$. At time T the good will break down with certainty.[10]

The seller then announces a policy of inspection to be described below, and offers a take-it-or-leave it price, p, knowing $\widetilde{T}$ and q but not the actual durability of the individual item.[11] The buyer[12] either accepts or rejects the offer, knowing $\widetilde{T}$, but knowing neither q nor the actual durability of the good, ϕ. If the buyer accepts the offer, she uses the good with the level of neglect $n(t)$, and derives utility $u(n(t))$ from usage. Let $n(t) \in [0, 1]$, where $n(t)$ is a (measurable) function on $[0, T]$, which maps from $[0, 1]$ into R, and where $u' > 0, u'' < 0, u'(0) = \infty$ and $u'(1) = 0$, to ensure an interior solution.[13]

Following Dybvig and Lutz, to create an easily solvable model, the stochastic process describing when dysfunction occurs is defined in terms of the absolute failure rate (i.e. the rate of failure in proportion to the original population). At time t, the absolute failure rate is assumed to be: $\phi_i + \lambda \int_{\tau=0}^{t} n(\tau)d\tau, i = l, h,$ where λ is a parameter > 0. It follows that the probability of dysfunction at time t or before is $F(t, \phi, n, \lambda) = \phi_i t + \lambda \int_0^t (t - \tau)n(\tau)d\tau,$ $i = l, h.$[14] A constant absolute hazard rate implies that the conditional probability of a good breaking down increases over time, i.e. the probability that

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[10] This assumption simplifies the analysis by allowing a particularly simple stochastic model, which can only be defined for a finite time period, see Dybvig and Lutz p.580.

[11] If the seller knew the actual durability, he would never investigate a valid claim, as he will do in the model.

[12] For simplicity there is only one buyer in the analysis and she buys only one good. This leaves out the possibility of sanctioning the seller based on the average durability of goods sold (which may reveal the seller's c).

[13] For simplicity, as in Dybvig and Lutz [5], the seller only incurs the production cost when there is a purchase.

[14] To ensure that this probability is lower than 1, it must be the case that $\phi_l + \lambda T^2/2 < 1$.

a good that survives until time t breaks down in the ensuing short time interval increases with t (since the absolute rate refers to the 'initial number of goods'). It should be noted that this formulation allows no interaction between the causes of dysfunction; the durability of the good ϕ does not affect the extent to which neglect on the part of the buyer causes dysfunction. This assumption of separability is made only to simplify the analysis; a sometimes more realistic model of 'joint causation' would complicate but would not alter the basic insight of the model.

If the good breaks down before $\widetilde{T}$, the optimal remedy is assumed to be replacement[15]. The seller is liable for the cost of replacement, R, if the good is defective ($\phi = \phi_l$) and if the defect has caused the dysfunction. Whether these conditions are fulfilled is assumed to be known to the buyer but not to the seller, who can, however, find out at a cost of inspection, I. If the seller decides to inspect the good and the buyer consents, whoever is proven wrong by the inspection pays for both replacement and inspection. The question hence arises how the parties will act in this inspection sub-game. We shall simplify this game by assuming that the seller can commit to a strategy of either inspecting or not inspecting the good. Which of these two strategies is optimal for the seller will depend on the probability that the good is defective, and this probability will decline over time, given the stochastic process just mentioned, by which the buyer's usage cumulative causes dysfunctions to arise. The seller will hence commit to investigate from some point in time onwards.[16] We shall consider the choice of the lawmaker at the margin and will assume that the seller will investigate claims at the cut-off time. The effect of relaxing this assumption is discussed below. Given the assumption that the buyer assesses the cause of the breakdown correctly, by committing to inspect the good, the seller ensures that the buyer will only raise claims that are valid.

When a good is replaced, the new item will be less likely to dysfunction because it has not been subject to cumulative usage. However, introducing this complication would render the analysis intractable, and nothing would be gained from this complication. Thus, for simplicity, it is assumed that the new item is subject to the same probability of breakdown as the old one was. Furthermore, we do not consider the case where the buyer experiences more

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[15]In many countries, the buyer can choose between replacement and repair, unless the cost of replacementis out of proportion to the benefit obtained by the buyer.

[16]Retailers have explained that they often use a time-contingent strategy.

than one dysfunction. This assumption is defensible when the probability of dysfunction is small.

The pay-off functions of the seller and the buyer can now be expressed in the following terms. Since the probability of a dysfunction in the interval $[0, t]$ equals $\phi_i t + \lambda \int_0^t (t - \tau) n(\tau) d\tau$, $i = l, h$, for any given usage-function, $n(t)$, the probability of a dysfunction occurring when the good is of low durability, that would not have incurred if the good were of high durability, is $(\phi_l - \phi_h) t$. When the seller spends c to affect durability, the probability that the good is defective is q, so the probability that the seller will have to pay for replacement and inspection in the interval $[0, t]$ is then: $q(\phi_l - \phi_h) t$.

Denoting the difference $\phi_l - \phi h$ by $\triangle \phi$, if the buyer accepts the offer, p, the seller obtains the income[17]:

$$p - \int_{\tau=0}^{\tau=\widetilde{T}} q \triangle \phi \, d\tau (I + R) - c(q)$$

The buyer pays for replacement (but never for inspection since she only raises valid claims) whenever the seller does not. The probability of a dysfunction in the interval $[0, T]$ is $q\phi_l T + (1 - q)\phi_h T + \lambda \int_0^T (T - \tau) n(\tau) d\tau$. Subtracting the probability that the seller pays for replacement, which equals $q \triangle \phi \widetilde{T}$, we obtain the cost to the buyer of replacement: $R(q \triangle \phi (T - \widetilde{T}) + \phi_h T + \lambda \int_0^T (T - \tau) n(\tau) d\tau)$

Thus, the buyer's pay-off is $\int_{\tau=0}^{\tau=T} u(n(\tau)) d\tau - R(q \triangle \phi (T - \widetilde{T}) + \phi_h T + \lambda \int_0^T (T - \tau) n(\tau) d\tau) - p$. Assuming that the buyer's reservation pay-off is zero, she will accept the seller's offer when the pay-off is positive.

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[17]We do not consider discounting the future.

3. Characterization of Equilibrium

An equilibrium is a cut-off period, $\widetilde{T}^*$, set by the policy-maker; a strategy of the seller consisting of an expenditure on durability, $c^*(q)$, a price p^*, a commitment to inspect, and a strategy of the buyer consisting of a purchase decision, a policy of usage (or neglect), $n^*(t)$, and a policy of only raising valid claims. We are interested in the Nash-equilibrium of this game.

To derive the equilibrium, note first that the choice of q is independent of the strategy chosen by the buyer, since the marginal probability of dysfunction caused by a change in q is independent of the buyer's usage. As mentioned, this separability significantly simplifies the analysis. If $n^*(t)$ is the buyer's optimal choice of neglect, and q^* is the probability of low durability given the seller's optimal choice of cost c^*, the buyer will accept an offer of p when

$$\int_{\tau=0}^{\tau=T} u(n^*(\tau))d\tau - R(q^*(\phi_l - \phi_h)(T - \widetilde{T}) + \phi_h T + \lambda \int_0^T (T - \tau)n^*(\tau)d\tau) \leq p.$$

Thus, the seller, who has all the bargaining power due to his ability to set a take-it-or-leave it offer, will set

$$p^* = \int_{\tau=0}^{\tau=T} u(n^*(\tau))d\tau - R(q^* \triangle \phi(T - \widetilde{T}) + \phi_h T + \lambda \int_0^T (T - \tau)n^*(\tau)d\tau).$$

Since the buyer cannot observe the seller's choice of q, the seller's optimal choice of $c(q)$ will be the solution to (A):

$$(A) : \text{Seller's problem: minimize w.r.t. } q : \int_0^{\widetilde{T}} q\Delta\phi(R + I)d\tau + c(q)$$

Note that q becomes a function of $\widetilde{T}$ through (A). In effect, (A) implies that:

$$c'(q) = -\Delta\phi(R + I)\widetilde{T}$$

which implies that $q = c'^{-1}(-\Delta\phi(R + I)\widetilde{T})$. We can denote the function $c'^{-1}(-\Delta\phi(R + I)\widetilde{T})$ by $q(\widetilde{T})$, to highlight the dependence of q on $\widetilde{T}$, and let $\varepsilon = \frac{q'(\widetilde{T})}{q(\widetilde{T})}$ be the elasticity of the $q(\widetilde{T})$ function.

The buyer's optimal choice of $n(t)$ is the solution to (B):

(B) : Buyer's problem: maximize w.r.t. $n(t)$:

$$\int_{\tau=0}^{\tau=T} u(n(\tau))d\tau - R(q \triangle \phi(T - \widetilde{T}) + \phi_h T + \lambda \int_0^T (T - \tau)n(\tau)d\tau)$$

This is equivalent to maximizing

$\int_{\tau=0}^{\tau=T} u(n(\tau))d\tau - R\lambda \int_0^T (T-\tau)n(\tau)d\tau)$, which amounts to full internalization

of costs of neglect. An optimal strategy for the buyer, $n^*(t)$, exists, given the boundary conditions on $u(n(t))$.

The policy maker seeks to maximize the sum of the pay-offs of the two parties (where the price p disappears, since it only constitutes a transfer):

$$\int_{\tau=0}^{\tau=T} u(n(\tau))d\tau - R(q\triangle\phi(T-\widetilde{T})+\phi_h T+\lambda\int_0^T (T-\tau)n(\tau)d\tau) - (\int_{\tau=0}^{\tau=\widetilde{T}} q\triangle\phi d\tau(I+$$
$$R) - c(q))$$

This is equivalent to minimizing w.r.t $\widetilde{T}$: $R(q\triangle\phi(T-\widetilde{T})+\int_{\tau=0}^{\tau=\widetilde{T}} q\triangle\phi d\tau(I+$

$R) + c(q)$ which can be rewritten as:

(C): Policy maker's problem:

$$\text{Minimize w.r.t } \widetilde{T} : \quad \int_0^T q(\phi_l - \phi_h)Rd\tau + \int_0^{T^*} q(\phi_l - \phi_h)Id\tau + c(q)$$
$$s.t.$$
$$q \text{ minimizes } \int_0^{T^*} q(\phi_l - \phi_h)(R + I)d\tau + c(q)$$

The policy maker's minimization problem illustrates the essential trade-off: a longer cut-off period entails a greater incentive for the seller to deliver

a good of durable quality, as can be seen from the incentive constraint, but also entails a longer period during which inspection costs might be incurred, as can be seen from the criterion function.

Proposition: In equilibrium:

1) The buyer chooses the socially optimal usage $n^*(t)$ which maximizes $\int_{\tau=0}^{\tau=T} u(n(\tau))d\tau - R\lambda \int_0^T (T-\tau)n(\tau)d\tau)$ and accepts the price p^*

2) The seller chooses the price

$$p^* = \int_{\tau=0}^{\tau=T} u(n^*(\tau))d\tau - R(q^* \triangle \phi(T - \widetilde{T}^*) + \phi_h T + \lambda \int_0^T (T-\tau)n^*(\tau)d\tau) \text{ and}$$

$q^* = c'^{-1}(-\Delta\phi(R+I)\widetilde{T}^*)$.

3) The policy maker sets $\widetilde{T}^*$ such that:

$$T - \widetilde{T}^* = -\frac{1}{\varepsilon}\frac{I}{R}$$

Proof of the Proposition: See Appendix A.

This intuitive and simple expression for the optimal cut-off period is the main result of the present paper. Since $q(\widetilde{T}) = c'^{-1}(-\Delta\phi(R+I)\widetilde{T})$, it is the

elasticity of the c'^{-1} function, and $\Delta\phi$, R, and I that determine the elasticity.

4. The role of unwarranted claims

In the model above, inspection costs were incurred only for warranted claims. However, buyers cannot always assess what caused the dysfunction. For example, in the case of electronic products such as a computers, electric currents (e.g. from lightning but also from other electronic equipment or gadgets) or downloads from unsafe sources can interfere with the functionality of the good without the buyer being aware of it. Moreover, buyers do not know what is legally considered a defective good. For these reasons, unwarranted claims occur, and their number may well rise over time, as the number of

dysfunctions increases. In particular, as the time of normal dysfunction approaches (as T approaches), uncertainty about whether dysfunctions should be considered defects may lead to costly claim resolution, e.g. in the form of inspections. In sum, the existence of unwarranted claims significantly strengthens the case for cutting off claims, and shortens the optimal cut-off period.

5. Application to markets for used goods

The model throws light on a debate concerning the advisability of differentiating between new and used goods, something which EU-directive 99/44/EF allows, but which not all member countries have done. In the Danish context, the committee of experts that advised the Parliament on the implementation of the EU-directive was opposed to differentiation, arguing that a buyer of a used good does not have a claim in the first place, unless the dysfunction is one that could not reasonably have been expected. The committee argued that this requirement would negate most claims, and that, therefore, a shorter period was not needed for used goods. In its report (betænkning) 1403/2001, p. 149, the committee stated that: ´the existing definition of what constitutes a defective good is sufficiently flexible to be able to accommodate the specific circumstances of such sales´. On the other side of the political hearings, the Danish Automobile Association advocated a shorter period for the sale of used cars, as one might expect, expressing the difficulty for sellers of *predicting dysfunctions* (Moegelvang and Lando, [13], p. 16).

The question arises how these arguments fare in light of the model. The cost c can be interpreted as the cost of checking the quality of the used goods, and then replacementing it if it is defective.[18] By checking and possibly repairing the good, the probability q of its defectiveness can be decreased. Thus, according to the model, the important variables for the determination of the length of the period are the elasticity $\varepsilon = \frac{q'(\widetilde{T})}{q(\widetilde{T})}$, and I and R. Hence, an important concern, expressed by $q'(\widetilde{T})$ is whether, by extending the period from, say, one to two years, the quality control will be much enhanced. The point made by the Danish Automobile Association is salient here: If dysfunctions that may occur in a year or two cannot be discovered by a (reasonably

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[18]Or informing the buyer of the defect in which case the cost c is only that of checking the quality.

thorough) quality check, such dysfunctions should not give right to remedies, as they will not have much incentive effect but will be likely to lead to claim resolution costs. Note also that if $q(\widetilde{T})$ is high, i.e. if the risk of dysfunction is high, the cut-off period should be short, as a high number of dysfunctions is likely to lead to many instances of claim resolution. Many used goods seem to be characterized by both a low preventive effect (a low $q^{'}(\widetilde{T})$) and a high probability of dysfunction (a high $q(\widetilde{T})$).

What, then, of the argument made by the committee of experts that the definition of a defective good will be sufficiently flexible to solve the problem, essentially by cutting off claims that arise after a considerable period of time? A problem with this argument is that a seller could be liable for repair or replacement of a good despite doing what could be expected of him to lower the probability of the good being defective; the rule is not one of negligence but of strict liability for defective goods. As mentioned above, the seller ideally should be liable in relation to the average performance of the goods he sells, but since aggregate data are not available and would be difficult to administer, the seller is likely to be liable for any good that breaks down. In other words, it is hard for the rules to regulate optimally the case of probabilistic dysfunction, and this casts doubt on the expert statement that 'the existing definition of what constitutes a defective good is sufficiently flexible'. In more concrete terms, if there is a 10% probability of a used car's electrical system dysfunctioning after one year, it is likely that the buyer will hold a claim against the seller whenever this occurs. If such claims do not improve incentives because the defect is unpredictable, there is a reason to cut them off as disagreement may well arise about the cause of the dysfunction or of the legal validity of claims.

6. Should the cut-off period be mandatory in consumer sales?

The present theory suggests that the cut-off period should reflect incentive effects and claim resolution costs, which may differ significantly between different consumer goods. For some goods, the optimal warranty is short but grants the buyer strong protection (by e.g. requiring the seller to prove the cause of the dysfunction) as argued by (Dybvig and Lutz [5]). Hence, it may be costly to impose a uniform mandatory minimum period. Moreover, freedom of contracting will leave more room for signaling of quality through the warranty period (Spence [19]). On the other hand, consumers will be required to inform themselves of the cut-off period that applies to durables such

as furniture, radios, stereos, coffee-machines, clothes, etc. This involves an information cost, and a possible inefficiency when consumers do not become informed. Whether the benefits outweigh the costs is an empirical matter.

7. Empirical evidence

The implementation in Denmark of EU Directive 1999/44/EC, which took effect at the beginning of 2002, extended the two cut-off periods - the default period and the (mandatory) minimum cut-off period for consumer sales- from one to two years. This legal change provided an opportunity to measure the importance of the cut-off period for both incentives and claim resolution costs (administrative costs).

As the effect of the new law began to show in its second year, a survey was conducted in 2003 (see [13]) involving retailers of durable goods. It obtained a response rate of some 300 out of 1300 questionnaires. The sectors covered were: used cars, new cars, computers and standard software, women's and men's clothing, electric home appliances, furniture, radio and television, shoes, and telecommunication products. We also obtained statistics from the Organization of Wholesale Distributors of Consumer Electronics in Denmark (BFE), which showed an increase in the number of repairs and replacements within this sector as a consequence of the extended cut-off period.

The data concern the effect on retailers' quality selection of goods and the effect on the number of claims and overall administrative costs.

7.1. Evidence Concerning the Impact on Incentives

Table 1 below shows that extension of the cut-off period seems to have affected retailers' quality selection of goods. The survey question was:

Have you, on the basis of the parameter in question 5a[19] or 5b (concerning the extension of the cut-off period), discontinued the sale of any goods that were resulting in too many complaints?

Table 1

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[19] Question 5a concerned whether customers bring claims more frequently than before.

Sectors	I	F	No	Do not know	answers
All sectors	14.2%	29.1%	53.8%	2.9%	275
Used cars	22.7%	36.4%	31.8%	9.1%	22
Cars	11.5%	19.2%	69.2%	.0%	26
Computers and software	18.8%	39.1%	39.1%	3.1%	64
Household appliances	18.2%	18.2%	59.1%	4.5%	22
Furniture	16.1%	19.4%	64.5%	.0%	31
Radio and television	12.5%	28.1%	59.3%	3.1%	32
Clothing	6.3%	28.1%	72.7%	6.3%	32
Shoes	10.0%	30.0%	60.0%	.0%	30
Telecommunication	6.3%	31.3%	62.5%	.0%	16

I: Yes, it has indeed affected our range of products

F: Yes, but only in very few cases

Thus, in the aggregate, *14% of the respondents answered that it had in fact influenced their selection while 29% had made changes but in only a few cases. The remaining 54% of sellers had made no changes.* This indicates that although many sellers are unaffected, seller behaviour has been affected in the direction one would expect, and to a non-negligible extent. Note that the questionnaire did not involve producers, but only sellers of goods; often the producer bears the cost of defects to a greater extent than the seller, so the preventive effect is likely to be larger. One other caveat should be mentioned. Although the question explicitly refers to the effect of the increase in claims, there is a possibility that the respondents failed to distinguish this from the effect of a simultaneous change in the presumption rule. The new presumption rule put the burden of proof on the seller for the first six months. Note, e.g, that selection has been more heavily affected in the case of used cars than new cars, which might well be related to the presumption rule. However, it is hard to imagine the presumption rule playing a very significant role in the case of televisions and radios, where a dysfunction shortly after purchase indicates an original defect (unless the item has been dropped in which case there will often be damage to suggest this). Yet, selection was significantly affected also for television and radios, suggesting that the extended cut-off period actually played a significant role.[20]

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[20]It should be added that some retailers may also been affected by he increased right for consumers to demand replacements. Survey responses revealed that there was a marked increase in the number of replacements, although many retailers simply disregarded the law in this regard (see Møgelvang-Hansen and Lando (2006)).

7.2. Empirical Findings Concerning Administrative Costs

The survey question was: Do your customers make more claims now than before the change of law? The possible answers were: a) Much more frequently, b) A little more frequently, c) No change, d) Do not know.

The answers are presented in Table 2:

Table 2

Sectors	M.m.f	L.m.f	No change	Do not know	answers
All sectors	6.2%	23.4%	67.0%	3.4%	291
Used cars	9.1%	31.8%	50.0%	9.1%	22
Cars	.0%	37.9%	62.1%	.0%	29
Computers and software	3.1%	16.9%	76.9%	3.1%	65
Household appliances	4.3%	17.4%	78.3%	.0%	23
Furniture	12.5%	28.1%	53.1%	6.3%	32
Radio and television	5.3%	15.8%	71.1%	7.9%	38
Clothing	.0%	24.2%	72.7%	3.0%	33
Shoes	9.4%	25.0%	65.6%	.0%	32
Telecommunication	23.5%	23.5%	52.9%	.0%	17

M.m.f: Much more frequently
L.m.f: A little more frequently

The survey also included the following question:

Question: Has the number of unwarranted claims increased after the change of law[21]?

	L. Inc.	S. inc.	No change	Fall	Do not know	answers
All sectors	7.7%	28.6%	56.8%	.0%	7.0%	287
Used Cars	19.0%	38.1%	33.3%	.0%	9.5%	21
Cars	.0%	46.4%	50.0%	.0%	3.6%	28
Computers/software	4.6%	20.0%	67.7%	.0%	7.7%	65
Household appliances	4.3%	17.4%	73.9%	.0%	4.3%	23
Furniture	9.4%	25.0%	50.0%	.0%	15.6%	32
Radio and TV	5.3%	23.7%	60.5%	.0%	10.5%	38
Clothing	.0%	25.0%	68.8%	.0%	6.3%	32
Shoes	16.1%	38.7%	45.2%	.0%	.0%	31
Telecommunication	23.5%	41.2%	35.3%	.0%	.0%	17

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[21] Again, noted that the law also shifted the burden of proof for the first six months which may have affected the results.

L. Inc: Large increase
S.inc: Small increase

There are significant differences between the different industries, reflecting a similar pattern to that for the increased number of claims. Overall, it appears that there was a larger increase in the number of unwarranted claims than in the number of claims: On average, 29.6% responded experiencing either a large or a small increase in the number of claims while more than 36% responded experiencing a large or a small increase in the number of unwarranted claims. This is at least indicative of a significant increase in unwarranted claims, at least as perceived by retailers, and strenghtens the point made above that unwarranted claims should be taken into account when setting the cut-off period. The evidence is hence consistent with a significant increase in the number of unwarranted claims due to the extension of the cut-off period.

8. **Discussion**

This section discusses some of the assumptions of the model and some aspects of reality that the model does not cover.

-The model assumes that the seller would commit to investigating claims at any point in time. In reality, the seller might wish to commit to a policy of investigating claims only after some point in time t' (as dysfunction initially is likely to be caused by a defective good, while neglect is more likely to be the cause with the passage of time), and only for goods of a certain value. However, as long as the seller will want to inspect before the expiry of the cut-off period, the exact t' will not affect the main result of this paper. For goods of low replacement value, for which inspections in some cases may never be optimal, sellers sometimes repair or replace at their own expense without investigating.[22] The situation will then be as in the literature on optimal warranties described above (Dybvig and Lutz [5], Cooper and Ross [4], and Emons [7]), where cutting off claims corrects the distortion created by buyer moral hazard. Again, the buyer moral hazard rationale complements the rationale based on claim resolution costs.

-It has been argued that the law should rather require a higher standard of proof as time passes, than cut off claims entirely. However, such a policy on the part of the court would be difficult to communicate effectively, and might lead to uncertainty and hence to costly litigation. Moreover, requiring a higher standard of proof would not diminish claim resolution costs in the situation analyzed in the model, since only warranted claims are raised. To eliminate claims, information concerning the average rate of dysfunction of the item sold would have to determine the validity of the buyer's claim.

-How the optimal cut-off period is affected by the existence of warranties (privately stipulated rules for non-performance) is not touched upon. To the extent that those goods that are supposed to last for many years are covered by warranties of longer duration, the optimal default and the optimal mandatory minimum rule, which then regulate goods of shorter expected lifetimes, will also be shorter.

-The model assumes declining marginal productivity of investment in durability. If the production function is convex, a marginal extension of the limitation period may be important to induce an efficient investment

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[22]This statement is based on interviews with retailers and with a firm that inspects claims for retailer in the television and computer industry.

level, as when a discrete investment in durability will only be undertaken if the cut-off period reaches a certain length. Still, at some point in time marginal productivity seems likely to decline.

-The remedy was assumed to be replacement. When the remedy is repair, the cost of inspection may be incurred automatically as part of the necessary diagnosis of the problem.[23] Claim resolution may then be costless. Hence, to the extent that repair is the optimal remedy, the claim resolution costs are likely to reside in the fact that the parties may continue to disagree after an inspection has been made, and may take the case to a dispute resolution board or to a court. Aggrievement costs may also play a role (Hart and Moore, [10]); a cut-off rule may eliminate the sense of aggrievement when the buyer acknowledges the law as a reference point for entitlements.

- The empirical evidence suggests that many consumer complaints are never voiced (e.g. Best and Andreasen [2]). This means that the seller's incentive is likely to be insufficient, although also unvoiced complaints hurt the reputation of the seller. In the model of the paper, this extends the optimal cut-off period since a longer period may be needed to provide the seller with incentives to undertake efficient investments in durability. Note, however, that if the rationale of the cut-off period lies in the existence of unwarranted claims, the existence of too few warranted claims may not call for a longer period, since what matters then is the ratio of warranted to unwarranted claims.

-The model does not attempt to capture the difficulties that arise when the remedies of consumer sales law, namely repair and replacement (i.e. specific performance) are given effect over a longer time span. For example, when repair is very costly, as tends to apply to certain complex or highly technological products, replacement becomes the only remedy. However, this is a costly remedy for the seller if a long time has passed since purchase. In the case of some products, the life-cycle is short due to technological progress, and it can be costly for the seller to maintain a stock of technologically outdated products (also, the seller is not always authorized by the producer to replace the old model with a new). If the seller cannot replace the old good, the buyer may prefer to obtain a refund of the price; if the price of the product falls over time due to technological advances, this can then enrich the buyer, which may not be part of an optimal scheme. Such complications

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[23]I am grateful to a referee for this point.

favor a shorter cut-off period, especially for certain categories of goods for which innovation is frequent. More generally, extension of the buyer's claim cannot be seen in isolation from the whole set of remedies, and a trade-off exists between affording the buyer strong protection and extending the buyer's remedies for a long time.

9. Summary

This paper argues that allowing buyers to raise claims for remedies is likely to be expensive over time in terms of claim resolution costs that are likely to be incurred when the buyer and the seller are asymmetrically informed about what has caused a dysfunction, or when they hold different beliefs about when a good is legally defective. By contrast, the negative effect of cutting off the buyer's claim for remedies on the seller's incentive to deliver durable goods is likely to decline in importance over time, at least from some point in time onward. Therefore, it is optimal to cut off the buyer's claim at some point in time.

The model enables a simple and intuitive determination of the optimal cut-off period from the cost of inspection, the cost of replacement, and the elasticity of the seller's incentive to prevent dysfunction as a function of the cut-off period. When applied to the case of used goods, this determination suggests that it is advisable to apply a shorter cut-off period to these, due to their lower elasticity.

To these factors must be added the existence of unwarranted claims. Their number is likely to increase over time as the number of dysfunctions increases, and this effect will of course shorten the optimal cut-off period.

Finally, the idea that the cut-off period has implications for incentives as well as for claim resolution costs has been confirmed by empirical evidence from the experience of extending the cut-off period in Denmark.

Appendix A.

The equilibrium choices of the seller and of the buyer follow from the discussion preceeding the proposition. As for the derivation of the optimal cut -off period, inserting the condition $q = q(\widetilde{T})$ from (A) into (C) yields:

$$Min_{\widetilde{T}} : \int_0^T (q(\widetilde{T})\Delta\phi R d\tau + \int_0^{\widetilde{T}} q(\widetilde{T})\Delta\phi I d\tau + c(q(\widetilde{T}))$$

An internal solution $\widetilde{T}^* \in]0, T[$ must fulfill:

$$T\Delta\phi R q'(\widetilde{T}^*) + \Delta\phi I(q'(\widetilde{T}^*)\widetilde{T}^* + q(\widetilde{T}^*)) + c'(q(\widetilde{T}^*)q(\widetilde{T}^*) = 0$$

which can be rewritten as

$$q'(\widetilde{T}^*)(T\Delta\phi R + \Delta\phi I\widetilde{T}^* + c'(q(\widetilde{T}^*)) = -q(\widetilde{T}^*)\Delta\phi I$$

Note that $c'(q(\widetilde{T}^*)) = -\Delta\phi(R+I)\widetilde{T}^*$ directly from (A). So the above can be written:

$$q'(\widetilde{T}^*)(T\Delta\phi R + \Delta\phi I\widetilde{T}^* - \Delta\phi(R+I)\widetilde{T}^* = -q(\widetilde{T}^*)\Delta\phi I$$

which implies that

$$q'(\widetilde{T}^*)((T - \widetilde{T}^*)\Delta\phi R = -q(\widetilde{T}^*)\Delta\phi I$$

This implies that the period which is cut off equals:

$$T - \widetilde{T}^* = \frac{-q(\widetilde{T}^*)\Delta\phi I}{q'(\widetilde{T}^*)\Delta\phi R} = \frac{-q(\widetilde{T}^*)I}{q'(\widetilde{T}^*)R} = \frac{-1}{\varepsilon}\frac{I}{R}$$

To check that there is no corner solution, it is necessary to look at two possibilities. It may be that $\widetilde{T}^* = T$ or that $\widetilde{T}^* = 0$.

Consider first the possibility that $\widetilde{T}^* = T$. Then, q^* minimizes $\int_0^T q\Delta\phi(R+ I)d\tau + c(q)$ which equals the total social cost. So, q^* is given by $c'(q^*) =$

$-\Delta\phi(R+I)T$. The criterion function reads

$$Min_{\widetilde{T}}:\int\limits_{0}^{T}(q(\widetilde{T})\Delta\phi R d\tau + \int\limits_{0}^{\widetilde{T}}q(\widetilde{T})\Delta\phi I d\tau + c(q(\widetilde{T}))$$

If $\widetilde{T}$ is decreased by a small interval $\partial\widetilde{T}$ (when $\widetilde{T}^* = T$),the effects are:

$q'^*(T)(T\Delta\phi R + \Delta\phi IT + c'(q^*(T))\partial\widetilde{T} - q^*(T)\Delta\phi I\partial\widetilde{T}$

Since $c'(q^*(T)) = -\Delta\phi(R+I)T = -\Delta\phi(R+I)T,$ it follows that $q'^*(T)(T\Delta\phi R + \Delta\phi IT + c'(q^*(T))\partial\widetilde{T} - q^*(T)\Delta\phi I\partial\widetilde{T} = -q^*(T)\Delta\phi I\partial\widetilde{T}$, hence

total costs are lower than before. The envelope theorem is at work: the effect through a lowering of q is nil, since the marginal savings achieved by the seller equal the marginal extra costs, as the seller is at an optimal point. Hence, $T = \widetilde{T}^*$ is not an optimal point. That $\widetilde{T}^* = 0$ is also not an optimal point r follows from the assumption that $c'(1) = 0$, which implies that there is no cost of lowering q below 1. This can be done by allowing the buyer to raise claims for a short period of time. When neither end point minimizes costs, the cost minimization point must be an interior point, and so must fulfill the first-order condition stated above.

$QED.$

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