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Market Regulation of Voluntary Add-on Contracts

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Abstract

This paper analyzes contract choices and the effectiveness of consumer protection policies when firms can offer voluntary add-on insurance for their products at the point of sale. We develop a model in which a base product can be sold together with a voluntary extended warranty contract that insures consumers against the risk of product breakdown. Some consumers do not pay attention to extended warranties before making a base product choice, but they overestimate the value of such warranties at the point of sale. Under retail competition, if the resulting extended warranty profits are sufficiently high, a no-arbitrage condition prevents the full profits from being redistributed to consumers via a lower base product price. Inducing competition in the extended warranty market weakly increases consumer welfare and weakly outperforms a minimum warranty standard, which can even reduce consumer surplus. The results of the paper are consistent with the effects of recent changes regarding extended warranty regulation by UK legislators.

JEL Codes: D18, D21, L13

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1 Introduction

In many retail industries, it is common for firms to offer consumers the option to buy an extended warranty for a product that they have just agreed to purchase. This is especially prevalent for many consumer electronics products, such as televisions, notebooks, and mobile phones. Arnum (2013) estimates a total of \$37.9 billion paid for extended warranty premiums in the US in 2013 across all industries.

Extended warranty practices have recently come under scrutiny from policy makers. In its 2002 consumer electronics extended warranty investigation, the British Office of Fair Trading concluded that “consumer protection in this market is inadequate” (OFT (2002)). OFT (2012) reports claims ratios, defined as the incurred claim costs relative to the insurance payments paid, for extended warranties in the UK consumer electronics industry. For 2002, the ratio is approximately 20 percent, compared with a 74 percent claims ratio in the UK’s general insurance industry. Extended warranty contracts are among the largest drivers of retail profits in many consumer electronics segments. Such contracts are often recommended by salespeople in stores but are rarely advertised in advance. According to Warranty Week (2005), extended warranty sales accounted for 3 to 4 percent of the revenues and more than 50 percent of the profits of the US retailer Best Buy in 2003.¹ Add-on insurance is also offered by a high proportion of low-cost airlines. Some airlines even set a default option of bundling a flight ticket with a costly travel insurance unless a consumer unchecks a box.

These facts lead us to two main questions: Is a special form of consumer protection needed for voluntary add-on contracts? If so, what is the optimal form of protection?

Section 2 introduces our baseline model in which retail firms compete in selling a homogeneous base product to consumers. The product has an exogenous probability of breakdown that is known to consumers. At the point of sale, retail firms can offer voluntary extended warranty contracts that insure consumers against the risk of product breakdown. A fraction of the consumers is naive and underestimates the costs of returning a faulty product. Evidence indicates that very few consumers in the consumer electronics industry shop around at different retailers with respect to extended warranty contracts.² Furthermore, extended

¹Competition Commission (2003) reports an estimated value of £900 million for the British consumer electronics extended warranty market, with 18.5 million extended warranties sold in a year. Businessweek (2004) reports that extended warranty contracts account for nearly 100 percent of the retailer Circuit City’s profits, with an estimated average profit margin between 50 and 60 percent; see also Chen *et al.* (2009).

²According to Rogers (2003b), only 4 percent of consumers said that they considered obtaining an extended warranty from a different provider than the one they had chosen. Using survey data, Westra (2002) reports that across all consumer electronics categories, roughly half of the consumers who purchased a consumer electronics product did not anticipate buying an extended warranty before purchasing the electronic product.

warranties are of very low priority with respect to consumers' base product choices. We therefore assume that consumers are locked in at the point of sale with respect to buying extended warranty contracts.³ This gives firms the opportunity to profitably sell extended warranty contracts to naive consumers. As a consequence, firms compete harder to attract these consumers by further decreasing the price of the base product below its marginal costs.

Section 3 derives our main model predictions and analyzes the effects of different consumer protection policies. Because the purchase of extended warranties is voluntary, prices for the base product cannot fall below zero because consumers could otherwise make an arbitrage profit by purchasing only base products.⁴ Therefore, if extended warranty profits are sufficiently high relative to the production costs of the base product, firms do not re-transfer all the extended warranty profits. Lower retail price bounds imposed by manufacturers can further increase industry profitability. This gives an explanation for the high profitability of extended warranties in many consumer electronics industries. We show that our results also hold qualitatively for alternative explanations, such as the overprediction of failure rates and loss aversion. The model setting relates to models with shrouded costly add-on prices and base product price floors; see, for example, Heidhues *et al.* (2014), building on the seminal work of Gabaix and Laibson (2006). The difference from these models is that in our model, naive consumers also make a voluntary choice about whether to buy an add-on extended warranty contract and that—apart from the return costs—all contract details are known. In our model, the base products are not deceptive. However, the voluntary add-on contracts are overpriced because of consumer naivete and the non-competitive market structure for these contracts. The key question that we assess is how different protection policies for voluntary add-on contracts change firm behavior and consumer choices.

A policy that induces extended warranty competition at each retail store through the presence of independent warranty providers always leads to zero profits for all firms and weakly increases consumer surplus. This occurs because of the presence of independent insurance firms that prevent a retailer monopoly for insurance contracts at the point of sale. Therefore, retail firms no longer have incentive to sell the base product as a loss leader.

³Rogers (2003a) asks consumers to rank the most important attributes for their product choices, and finds that consumers pay the most attention to product reliability, durability, ease of use, and price. Moreover, consumers consider size, color, and brand. Both the manufacturer's guarantee and extended warranties always rank behind all of these attributes in the range of the least important attributes.

⁴Gabaix and Laibson (2006) show that when some consumers are myopic with respect to delayed add-on fees, there exist equilibria in which firms do not advertise these fees. Also see Heidhues *et al.* (2014), Armstrong and Vickers (2012), and Grubb (2015) for models with base price floors in markets with delayed add-on fees. In contrast to these models, consumers in our model make a cognitive choice to purchase a voluntary extended warranty contract upfront.

Overall, naive consumers weakly benefit from such a policy, while sophisticated consumers are weakly hurt by it.

A minimum warranty level has ambiguous effects on consumer surplus. It decreases naive consumers' predicted value of a higher extended warranty contract. However, when sophisticated consumers return a defective product with positive probability and incur return costs, these frictions have a negative effect on consumer surplus. If these frictions are sufficiently high relative to the reduction in the prices of extended warranty contracts, the overall effect of this policy on consumer welfare is negative.

A policy that allows canceling an extended warranty contract for a fixed period of time after signing the contract induces a change in firms' contract offerings only if all consumers are willing to change the contract. If this does not occur, the policy is inferior to inducing competition at the point of sale.

We provide several conditions under which a "shrouding" equilibrium persists in which firms do not advertise their extended warranty quotes to consumers. This is the case, for example, when consumers become aware of a competitive insurance market or when they do not expect the purchase of an extended warranty contract prior to visiting a store to buy a base product. Overall, our results clearly indicate that inducing competition at the point of sale is the most favorable protection policy when possible, as the policy always maximizes consumer welfare while avoiding the risk of negatively affecting the market.

Section 4 discusses several policy applications and model extensions. We first show that our model predictions can capture many of the effects of the UK 2005 Extended Warranty Order, a policy designed to improve competition for extended warranty contracts in the consumer electronics industry. The law includes a cancellation right for consumers, the right to shop around for other extended warranty quotations, and a mandatory information leaflet distributed before signing. Consistent with our model, after introduction of the policy, claims ratios in the market increased, although they were still significantly lower than the ratios in most other industries. This indicates an increased level of competitiveness in the market for extended warranties with some remaining frictions.

We further show that our setting can easily be applied to the profitability of mail-in rebates; see, for example, Bar-Gill (2007) for an extensive legal description of the problem. Finally, we discuss firm practices for selling costly add-on insurance together with base products as a default and a policy that requires consumers to make active choices. This relates to practices in many internet markets, such as the market for booking flight tickets and hotel rooms, in which some firms include a costly add-on insurance as a default option.

Section 5 provides an overview of the related theoretical literature. Section 6 concludes.

2 Baseline model

There are $M \geq 2$ retail firms in the market, all selling an identical base product with quality q and marginal cost c . In this context, the marginal cost of production c can also be interpreted as the exogenous upstream price that each firm must pay to a manufacturer. The quality q reflects the probability of the product working properly and is known to consumers. Each firm i sets a base product price p_i and offers an individual menu of extended warranty contracts $\Gamma_i = \{\gamma_j^i\}_{j=0}^{m_i-1}$, where m_i denotes the number of distinct warranty contracts for product i and is chosen by the firm. An extended warranty contract $\gamma_j^i \equiv (x_j^i, w_j^i) \in \Gamma_i$ grants a consumer a payment w_j^i in case of product breakdown at an extra price x_j^i that he must pay upfront in addition to the product price p_i . For notational simplicity, a base product is associated with a zero manufacturer warranty, such that all positive extended warranties are offered by the retailer. This is consistent with many consumer electronics retailers offering their own extended warranty contracts; see, for example, OFT (2012) for recent evidence. Thus, we require a costless zero default extended warranty contract $\gamma_0 = (0, 0)$ to be included in the menu of warranty contracts for each product i . We assume that there is a finite maximum warranty level \bar{w} that the firm can offer.⁵

Consumers are risk neutral.⁶ They value the consumption of a properly working product with utility $I > 0$ and derive zero utility from consuming a malfunctioning product. Thus, the expected utility from consuming a product is qI . Consumers receive a disutility $-p - x$ from paying a total price $p + x$ for both the product and a warranty. They derive positive consumption utility only from consuming a single product. We do not consider cases in which consumers can influence the breakdown probability.

A key feature of our model concerns the payment of the warranty in case of product breakdown. To receive the warranty payment, a consumer must send the product back to the firm, which incurs socially wasteful costs r to the consumer. Return costs are distributed according to the differentiable cumulative distribution function (henceforth, cdf) $F(r)$. For simplicity, we assume that the distribution of return costs does not depend on the specific warranty contract and thus cannot be influenced by the firm. The draw of r is unknown to each consumer prior to the purchase of both the product and warranty contract. This eliminates any selection effects from privately known consumer return costs.

The two different consumer types in the market differ in how they anticipate return costs.

⁵The upper bound on warranties may not be needed, but it eliminates outcomes in which firms offer infinite warranty contracts. One natural boundary is $\bar{w} = I$, i.e., the maximum willingness to pay for a working product.

⁶In Appendix B, we discuss microfoundations of return cost misperceptions, such as hyperbolic discounting, loss aversion, and misprediction of failure rates. We show that these specifications qualitatively lead to similar outcomes.

A fraction $1 - \theta$ of consumers is “sophisticated” in the sense that they correctly predict the distribution of return costs. The remaining fraction θ of consumers is “naive” in that they erroneously underestimate the costs of returning the product, i.e., the anticipated distribution of return costs. Despite having the same return costs cdf $F(r)$ as the sophisticated consumers, the naive consumers believe that the distribution of return costs r in the whole population can be described by the differentiable cdf $\tilde{F}(r)$. We assume that F first-order stochastically dominates $\tilde{F}(r)$ for the full support of the functions, i.e., $\tilde{F}(r) \geq F(r) \forall r \in (0, \infty)$, with $\tilde{F}(r) > F(r)$ for $r \in (0, \bar{w}]$. This implies that naive consumers underestimate their return costs for all positive warranty levels and that there is always a positive probability of facing return costs $r > 0$. This formalization allows for relatively flexible consumer return patterns.⁷ At the time of product breakdown, consumers learn their true cost draw r . They claim the warranty payment when it is at least as high as the return cost draw, i.e., when $w \geq r$.

Consumer utility A sophisticated consumer’s expected utility of consuming a base product of quality q at price p associated with warranty contract γ , $V(q, p, \gamma)$, can be written as

$$V(q, p, \gamma) = qI - (p + x) + (1 - q) \int_0^w [w - r]f(r)dr. \quad (1)$$

The first part on the right-hand side reflects the expected utility from consuming a product. The second part is the disutility that a consumer derives from the price of both the base product and warranty. The third part is the expected utility from the warranty payment conditional on returning a defective product, where $f(r)$ is the return cost probability density function. With $\tilde{f}(r)$ denoting a naive consumer’s predicted return cost probability density function, the analogous expected consumption utility of a naive consumer can be written as

$$\tilde{V}(q, p, \gamma,) = qI - (p + x) + (1 - q) \int_0^w [w - r]\tilde{f}(r)dr. \quad (2)$$

Timing of the game Firms simultaneously set their base product prices and menus of extended warranty contracts. Consumers initially observe only the base product prices and either choose a retailer to buy at least one base product from or choose not to buy any product. We assume that consumers derive no additional consumption utility from consuming more than one product. At this stage, no consumer observes the firms’ menus of extended warranty

⁷Using our specification for the cost distributions allows both for equilibrium warranty levels that are below the maximum warranty level \bar{w} and for consumers to return a product in equilibrium with positive probability. When we allow for only one cost outcome r that naive consumers underestimate, in equilibrium, naive consumers never return a faulty product if this cost is sufficiently high. This is not a desirable property given the small but yet positive claim ratios in related industries.

contracts. Sophisticated consumers can correctly infer the equilibrium menus of extended warranty contracts, while naive consumers are myopic with respect to the existence of these contracts at this stage.⁸ The sequential modeling assumption is consistent with evidence that very few consumers shop around for extended warranties and that many of them do not anticipate their purchase of extended warranties. After making a base product purchase from retailer i at the point of sale, consumers observe their retailer's menu of extended warranty contracts Γ_i . At this point, consumers decide whether to buy an additional extended warranty contract.⁹

Equilibrium Definition We seek a combination of base product prices and menus of extended warranty contracts that maximizes firms' profits given their competitive constraints. We assume that the two consumer types are indistinguishable from one another before making purchase decisions. The consumer types can differ in their utility predictions for each contract because naive consumers underestimate their return costs.

Definition (Industry Equilibrium) An equilibrium for $M \geq 2$ firms consists of a set of base product prices $\{p_1, \dots, p_M\}$ and a set of associated menus of extended warranty contracts $\{\Gamma_1, \dots, \Gamma_M\}$ with the following properties:

1. (*Firm profit maximization*) For any firm i , given its rivals' base product prices and menus of extended warranty contracts, there is no combination of base product price p_i and menu of extended warranties Γ_i that leads to a higher expected profit.
2. (*Optimal decision for sophisticated consumers*) Sophisticated consumers make a base product and extended warranty contract choice that yields the highest expected consumption utility. These consumers do not observe the menu of extended warranty contracts before making a base product choice, and they claim a warranty payment when the payment is at least as high as their return costs.
3. (*Hypothetical optimality for naive consumers*) Naive consumers make a base product and extended warranty contract choice that yields the highest expected consumption

⁸While all consumers buy at most one product in equilibrium, the possibility of buying multiple products prevents firms from setting negative base product prices because of arbitrage. The equilibrium results are identical in the case in which sophisticated consumers are also initially myopic with respect to the existence of extended warranties.

⁹An alternative to consumers being offered an extended warranty contract only after making a base product purchase involves introducing a search cost ϵ derived from visiting another store to obtain another extended warranty quote. If naive consumers become aware of the extended warranties only at the point of sale but before making a base product purchase and if the search costs for shopping around are sufficiently high, then in equilibrium, all consumers make a purchase from the first retailer that they visit.

utility in the virtual case in which their return costs are represented by the cdf \tilde{F} . These consumers do not anticipate the existence of extended warranties before making a base product choice, and they claim a warranty payment when the payment is at least as high as their return costs.

Under this definition, both consumer types maximize their initial predicted utilities. Firms and sophisticated consumers are aware of naive consumers' false beliefs, while naive consumers believe that all consumers and the firm share the same beliefs about the return cost distribution. In section 3.3, we also analyze the case in which firms can choose to “unshroud” the extended warranty in the industry contracts before consumers make a base product purchase. In that section, we show the conditions for which a shrouding equilibrium persists.

3 Industry equilibrium and evaluation of protection policies

3.1 Industry Equilibrium

Because consumers make an extended warranty choice only after making the decision to purchase the base product, this implies that retailers have a quasi-monopoly for extended warranty contracts at the point of sale. Due to the underestimation of return costs, there are cases in which retailers can sell extended warranties to naive consumers at positive markups. Intuitively, this can occur when a naive consumer's predicted net utility from an extended warranty is higher than a retail firm's expected cost of paying the warranty.¹⁰ Formally, this is the case if

$$\tilde{\pi}(q, w) \equiv (1 - q) \left[\tilde{F}(w) \tilde{E}[w - r | w > r] - F(w)w \right] > 0, \quad w \in (0, \bar{w}).$$

When there exists at least one positive warranty level for which this inequality holds, each firm sells positive extended warranties to naive consumers in equilibrium. The firm sets a warranty level \tilde{w} to maximize the value of the left-hand side of the above inequality. As a price for the extended warranty, the firm charges a naive consumer's predicted willingness to pay, $(1 - q) \tilde{F}(\tilde{w}) \tilde{E}[\tilde{w} - r | \tilde{w} > r]$. In cases with multiple warranty levels that maximize the firm's profits, we assume that the firm chooses the lowest among these levels.¹¹ However, to attract

¹⁰While “peace of mind” is an often stated reason for consumers to buy an extended warranty contract, this does not eliminate the possibility of underestimating the return costs. Rogers (2003b) reports the most important reasons cited by sales personal while advising consumers to buy an extended warranty. The four most frequently used reasons remembered by consumers were “no repair costs” (17 percent), “peace of mind” (17 percent), “good value for money” (11 percent), and “free/no cost” (6 percent).

¹¹If multiple profit-maximizing warranty levels exist, the firm chooses the warranty level that minimizes return costs and thus leads to the highest consumer surplus.

naive consumers to buy extended warranties, retailers compete harder on the base product price, which induces a decrease in the base product price below marginal costs. Because firms cannot distinguish between naive and sophisticated consumers ex ante, sophisticated consumers benefit from this loss leadership by having to pay a lower price for the base product. Therefore, consumer naivete causes a transfer in utility from naive to sophisticated consumers under competition. The lower bound on base product prices implies that if the profits of extended warranties are sufficiently high relative to the production costs c , firms will not redistribute all profits back to consumers in equilibrium. Otherwise, consumers would receive a payment for a base product, which would give them the option of earning unlimited arbitrage profits from buying only base products. As a consequence, retail firms set a base product price of at least zero, and in the above case make positive profits in equilibrium due to not redistributing all profits from selling extended warranty contracts.

Proposition 1. *(Retail competition with extended warranty monopoly at point of sale) Suppose that there are $M \geq 2$ firms in the industry. In equilibrium, each firm i with positive market share sets a base product price $p_i = \max[0, c - \theta \tilde{\pi}(q, \tilde{w})]$, together with a menu of extended warranty contracts $\Gamma_i = \{(0, 0), (\tilde{x}, \tilde{w})\}$, where*

$$\tilde{w} = \inf \left[\arg \max_{w \in [0, \bar{w}]} \tilde{\pi}(q, w) \right], \text{ and } \tilde{x} = (1 - q) \tilde{F}(\tilde{w}) \tilde{E}[\tilde{w} - r | \tilde{w} > r]. \quad (3)$$

Sophisticated consumers always buy only the base product. If $\tilde{w} > 0$, naive consumers buy a positive extended warranty contract in addition to the base product. When there exists a profitable extended warranty contract for firms, sophisticated consumers' utility is weakly increasing in the fraction of naive consumers.

Rearranging the profit equation from the proposition, we find that all firms make positive profits in equilibrium if $\theta > \frac{c}{\tilde{\pi}(q, \tilde{w})}$.

Corollary 1. *If $\theta > \frac{c}{\tilde{\pi}(q, \tilde{w})}$, all firms make positive profits in equilibrium.*

Chen *et al.* (2009) find that promotions of a base product increase the probability of selling extended warranties. The authors attribute this effect to an increase in spending resulting from an emotional gain because of the decrease in the base product price. In our model, the reasoning is the opposite: because firms earn higher profits from products that are sold with extended warranties, they compete harder for them by giving discounts on their base products. Contracts between retailers and manufacturers regarding the minimum retail price can place an even stricter lower bound on prices and can lead to higher industry profits.¹²

¹²Such a minimum retail price can, for example, be set to preserve a high brand value for the manufacturer's product.

If a lower bound for the base product price is at least as high as the marginal costs c , this implies no transfers between the different consumer types. Conversely, without such a lower bound, if the marginal costs of production are higher than the profits that can be extracted because of the extended warranties, then firms never obtain positive profits because all extended warranty profits are competed away via loss leadership of the base product. In the latter case, sophisticated consumers always benefit from each additional naive consumer.

Corollary 2. *If $\frac{c}{\bar{\pi}(q, \tilde{w})} > 1$, sophisticated consumers' utility is strictly increasing in θ .*

3.2 Evaluation of consumer protection policies

In this subsection, we analyze the effectiveness of three policies, namely, inducing competition at the point of sale, having minimum required warranty levels, and implementing a cancellation policy for extended warranty contracts.

Competition for extended warranties at the point of sale Suppose that every retail firm is required to show consumers warranty quotes from independent extended warranty providers before it can sell an extended warranty contract. With competition among extended warranty providers at the point of sale next to retail competition for base products, the prices for extended warranty contracts decrease to the expected claim costs, $(1 - q)F(w)w$. Base product prices increase to marginal costs. This eliminates all industry profits. Furthermore, this outcome stops the transfer from naive consumers to sophisticated consumers.

Proposition 2. *(Effects of extended warranty competition at point of sale) Suppose that there is competition for extended warranties at the point of sale. In equilibrium, each retail firm i with positive market share sets a base product price $p_i = c$ and offers at least one default extended warranty contract $\gamma_0 = (0, 0)$. Naive consumers buy an extended warranty contract $\gamma_c = (x_c, \tilde{w})$, where \tilde{w} is defined by equation (3), and $x_c = (1 - q)F(\tilde{w})\tilde{w}$. All firms make zero profits in equilibrium. If $\tilde{w} > 0$, the policy increases consumer surplus and does not change overall welfare.*

Minimum required warranty level In cases in which firms can profitably sell positive extended warranty contracts to naive consumers, the adoption of a positive minimum warranty

Furthermore, a sufficiently low base product price might cause naive consumers to become suspicious about an offer being “too good to be true,” thus preventing them from buying a positive extended warranty contract. Heidhues *et al.* (2014) present a microfoundation of consumer suspicion in which consumers are uncertain about firms' marginal costs. In their setting, consumer suspicion itself can be a reason for a lower bound for the base product price in equilibrium.

level $w^{min} \leq \tilde{w}$ has ambiguous effects. Such a policy lowers the appeal of the purchase and thus also reduces the prices of positive extended warranty contracts for naive consumers. This result weakly lowers the degree of loss leadership of the base products. As a consequence, cross-subsidization of sophisticated consumers through the extended warranty profits made by naive consumers is weakly reduced. However, a positive minimum warranty level weakly increases the return costs that sophisticated consumers face. In cases in which firms make zero profits, the extra return costs paid by sophisticated consumers lead to a decrease in the overall consumer surplus.

Proposition 3. *(Effects of minimum warranty level) Any positive minimum default warranty level w^{min} , $0 < w^{min} \leq \tilde{w}$, weakly hurts sophisticated consumers but has a weakly positive effect on naive consumers. The overall effect on consumer surplus is ambiguous. The policy weakly decreases welfare.*

Another form of consumer protection is a free cancellation policy. While such a policy usually expires after the first use of a product for physical products such as TVs and notebooks, such a strong expiration policy is not needed for add-on insurance contracts such as extended warranties and for many financial products. In the 2005 UK Extended Warranty Order, a mandatory 40-day cancellation period was also included.

Free extended warranty contract cancellation policy The UK's 2005 Extended Warranty Order grants consumers the right to cancel an extended warranty contract within the first 40 days after signing the contract. We assume that a fraction $\beta \in (0, 1]$ of consumers becomes aware of all other extended warranty contracts in the market after purchasing a base product and potential extended warranty choice at a retailer. In such a case, consumers can cancel their old contract without costs and switch to the new contract.¹³ A potential product breakdown occurs only after this opportunity to switch or cancel the initial contract. Furthermore, we assume that there are at least two independent warranty providers in the market that do not offer any base product and that set their warranty contracts after observing the base product prices. This relates to a relatively competitive independent insurance market.

A free cancellation period does not change naive consumers' beliefs about their return costs. Therefore, these consumers are still willing to paying the same maximum amount for an extended warranty contract as before and would cancel an extended warranty contract only if they receive a contract with a better offer. If $\beta < 1$, i.e., if some consumers do

¹³ β can account either for consumers' unawareness of rival offers or for additional switching costs that prevent some consumers from changing their contracts.

not understand the possibility of returning their products, then our results show that retail firms do not have any incentives to change their contract structures.¹⁴ This lack of incentive to change contract structures is evident because retail firms know that they will never be able to derive a positive markup from naive consumers who become aware of rival contracts, and therefore, these firms focus on maximizing the profits from consumers who will never switch. Therefore, all naive consumers that become aware of the option to switch contracts immediately switch to an extended warranty contract that the different independent insurers offers at zero markup. When some consumers do not become aware of rival offers, this policy is thus inferior to inducing competition at the point of sale. If $\beta = 1$, the policy is as effective as inducing competition at the point of sale. In this case, there are equilibria in which all retail firms switch to the policy of offering competitively priced extended warranty contracts.

Proposition 4. (*Effects of extended warranty cancellation policy*) *Suppose there is a money return policy, $M \geq 2$ retail firms and at least two independent extended warranty providers.*

1. *If $\beta < 1$, in equilibrium, each firm with positive market share sets the same menu of extended warranty contracts as in the case without intervention. A fraction β of naive consumers cancels their initially purchased extended warranty contracts and switches to a competitively priced contract from an independent retailer.*

2. *If $\beta = 1$, in equilibrium, all firms earn zero profits, and all consumers end up purchasing a competitively priced extended warranty contract.*

The proposition shows that a free cancellation policy alone can affect the retail firms' incentives to change their warranty contract structures only if all naive consumers are aware of the possibility of return. In these situations, the policy leads to the same consumer surplus outcome as inducing competition at the point of sale. If some naive consumers are not aware of the cancellation option, those who are aware of the cancellation policy switch to an independent extended warranty provider. Those who are unaware of this option do not switch options and have the same expected utility as before. Note that we did not consider other costs of policy cancellation arising from negative emotions and opportunity costs of time. Such considerations could further reduce the efficiency of the policy

Overall, if competition at the point of sale can be effectively introduced, this is always at least as efficient (from an overall consumer surplus perspective) as the introduction of a

¹⁴Inderst and Ottaviani (2013) analyze the effect of a money return policy in a cheap talk game in which a seller tries to convince a buyer of the suitability of a product. In their model, when consumers are "credulous", i.e., when they believe the advice of a self-interested salesperson, a minimum refund level enhances the overall surplus and efficiency. The results differ from ours because of the absence of externalities between different consumer types in their model and because returns for their products are not costly.

minimum warranty standard or a free cancellation policy. Furthermore, induced competition does not have the risk of distorting the market negatively with respect to consumer surplus that a minimum default warranty level might have.

3.3 Unshrouding of extended warranty contracts

We next consider the case in which each firm has the opportunity to “unshroud” the menus of extended warranty contracts Γ of all firms and thus to make naive consumers aware of the possibility of buying an extended warranty contract before they purchase a base product. This follows the work of Gabaix and Laibson (2006) and, in particular, Heidhues *et al.* (2014). The following corollary provides sufficient conditions for a shrouding equilibrium to exist for any number of firms in our model, which will subsequently be discussed.

Corollary 3. *Assume at least one of the following three assumptions holds:*

1. *When a retail firm unshrouds the extended warranty contracts, naive consumers become aware of a competitive insurance market for extended warranties.*
2. *Unshrouding the extended warranty contracts makes naive consumers fully sophisticated.*
3. *Naive consumers do not anticipate that an extended warranty can be of use to them before making a base product purchase, even if the extended warranty contracts are unshrouded. Then, the equilibrium in Proposition 1 is a shrouding equilibrium for any number of firms.*

There are several reasons why disclosing extended warranty quotes may not be profitable for a retail firm. The existence of a competitive insurance market on the internet can lead to retailers shrouding their extended warranty contracts in equilibrium if unshrouding those contracts also induces consumer search for the lowest extended warranty price available. Assume that if a retailer discloses the extended warranty contracts in the industry before consumers enter a store, then consumers start searching for extended warranty quotes from an independent competitive insurance market, such as from providers on the internet. This leads to Bertrand competition for extended warranties and to zero firm profits for retailers. Thus, disclosing warranty quotes is not profitable for any retail firm in this case.

A second case in which unshrouding is not profitable for firms arises if disclosing the extended warranty quotes makes naive consumers fully sophisticated, i.e., causes them to have correct beliefs about their return costs. In this case, unshrouding the extended warranty quotes reduces the willingness to pay of naive consumers, such that a retail firm can never earn positive profits from selling a positive extended warranty.

Third, additional survey evidence suggests that extended warranties are of the lowest priority for consumers when it comes to making initial base product decisions among all

available product attributes; see, for example, Rogers (2003b). This evidence suggests that even if firms advertised these quotes, many consumers would not pay attention to them before making a product purchase, such that lowering the prices of extended warranty contracts and disclosing them would not significantly affect the base product’s demand. Furthermore, in many cases, lowering extended warranty quotes for firms would result in the firm needing to increase the base product price. In cases in which consumers initially pay attention only to the base product price, this would result in zero demand for a firm that decreases the prices of its extended warranty contracts.

In practice, the unshrouding of rivals’ warranty prices seems to be both difficult and costly for firms. Retailers often do not freely post their extended warranty quotes; therefore, gathering these quotes is difficult. Moreover, advertising these quotes publicly through advertising is costly in practice and might also confuse consumers because of the increased complexity of the quoted contracts, which is something we abstract from in our model. If the overall cost of unshrouding is greater than the market profits from extended warranties, the firm will never educate naive consumers about the extended warranty contracts in the market.

In all of the above cases, unshrouding the extended warranty quotes leads to a decrease in the profits of an unshrouding firm, such that each retail firm prefers the shrouding equilibrium to a non-shrouding equilibrium.

4 Applications and Extensions

4.1 The 2005 UK Extended Warranty Order

After an in-depth market investigation, in 2003, the UK’s Competition Commission found that there is insufficient competition for extended warranties in the consumer electronics industry and that a “complex monopoly exists.” The Competition Commission argued that prices for extended warranties in this industry have typically not been displayed, cancellation periods for such contracts have been short, and consumers have lacked both information and choices about different extended warranty providers at the point of sale. As a result, the legislature passed the Supply of Extended Warranties on Domestic Electrical Goods Order 2005, which came into force on April 6, 2005. This order includes a cancellation right for consumers, the right to shop around for other extended warranty quotations, and a mandatory information leaflet to be provided before signing.

OFT (2012) finds an increase in the claims ratio from 20 percent to approximately 50 percent six years after the law was introduced. Although it is increasing, this number is still relatively low compared with other markets: in the UK general insurance industry, the

OFT finds on average a 74 percent claims ratio, including a 62 percent claims ratio for property insurance. The fraction of consumers who shop around also increased from 4 to 25 percent in the same period. Unsurprisingly, those consumers who researched products online were particularly likely to receive multiple offers and more likely to buy extended warranty contracts online. However, only 18 percent of retail extended warranty customers stated that they had shopped around. In comparison, the OFT reports that 69 percent of general insurance customers shopped around the last time they renewed their contract.¹⁵

There are at least two ways to interpret these observations. First, the mandatory information disclosure about return and cancellation policies could have led to suspicion of extended warranties and therefore decreased the willingness to pay for these products. This result would translate into a change in the predicted return cost cdf \tilde{F} toward the actual cdf F . Second, the law could have led to more shopping around for consumers and thus to higher competitive pressure. One such example would be two independent extended warranty providers that offer the extended warranty at the expected claim cost when only a fraction of consumers will become aware of this option. OFT (2012) argues, however, that there are still high margins in the industry because of the remaining quasi-monopoly position at the point of sale, especially for retailers with the largest market shares.

4.2 Broad categories and few contract options for extended warranties

Prices for extended warranty contracts are typically pooled together for several products and even product classes, ignoring different breakdown probabilities for products. Furthermore, there is very low volatility in the prices of extended warranty contracts. OFT (2012), for example, notes that between 2003 and 2011, the UK retailer Dixons changed its prices for extended warranty contracts only five times.¹⁶ This has several possible explanations. First, having a single contract for different products can make the derivation of a firm's optimal warranty contract more difficult and could thus prevent suspicion with respect to exploitative contracts. Along the same lines, giving consumers only one contract option might prevent them from thinking about the usefulness of large extended warranty coverages compared with smaller ones. Second, having only a single contract can lower the administrative costs for a retailer. Third, a single contract might also prevent consumers from believing that extended

¹⁵Furthermore, industry reports indicate an increased entry of manufacturers in the extended warranty market for high-value product such as washing machines and high-quality televisions.

¹⁶According to Rogers (2003b), across all product price ranges, 33 percent of consumers buy extended warranties for electronic goods. Consumers also frequently buy extended warranties for low-priced products: for products up to a price of £100, 25 percent of consumers buy an extended warranty, while the figure is 27 percent for products between £101 and £200.

warranties are a measure used by firms to increase profits.

4.3 Mail-in rebates

Our setting can also be used to explain the existence of money-return mail-in rebate policies.¹⁷ Dhar and Hoch (1996) conduct field experiments to compare how consumers react to both redeemable coupons and off-the-shelf price discounts. Their results indicate that coupons lead to both a higher increase in the number of sales and higher profits compared with the price discounts, as only an average of 55 percent of consumers redeem the coupons. To adapt such behavior to our framework, consider a single firm that produces a base product of quality 1. When sending back a coupon, the consumer receives a late discount worth w . Because of the consumer's certainty about the quality, he is thus willing to pay a total amount I for a product. When only sophisticated consumers are present, it is always optimal to sell a base product at price $p = I$. However, when naive consumers are also present, the firm can offer mail-in rebates at an additional price $\tilde{\pi}(0, w)$, which gives the right to a later payment worth w . Because naive consumers underestimate their return costs, firms can increase their profits by offering these mail-in rebates. This can also be extended to another promotional tool for firms: the delayed rebate payment is considered a price cut by consumers. However, this price cut benefits only the subset of consumers who claim the rebate.

4.4 Add-on insurance and default choices for internet purchases

Voluntary add-on insurance is regularly offered for several products that are sold over the internet. Typically, these offers appear toward the end of the purchase process, when consumers have already invested time into filling in their personal information. Prominent examples are additional travel sickness insurance, insurance against the risk of not being able to fly or use a hotel room, and insurance against the risk of bankruptcy of an airline carrier. While add-on insurance cannot be advertised by a salesman as would, for example, products sold in a retail store, there is another option to increase the sales of insurance in these cases. A firm can set the purchase of add-on insurance together with a base product, e.g., a flight ticket, as the default option in the purchasing process. A consumer who does not want such an option must uncheck a box. Such practices have been adopted by several airlines, as they can increase firm profits when some consumers are inattentive to the costly default option. In such a case, a simple regulation that can improve consumer surplus is the requirement to

¹⁷Also see Bar-Gill (2007) for a discussion and an example of a rebate misperception problem. Jolson *et al.* (1987) provide further evidence that firms use redeemable rebates as a promotional tool as well because many consumers do not use them and end up paying the full price.

either set the choice to not buy insurance as the default or to require an active choice by checking a box to complete a purchase. This still allows the purchase of add-on insurance but prevents inattentive consumers from buying unwanted insurance contracts.

5 Related theoretical literature

Our paper is primarily related to the literature on hidden add-on fees and consumer myopia in behavioral industrial organization and to the literature on warranties in both law and industrial organization. Previous work in the behavioral industrial organization literature establishes conditions under which firms choose not to disclose add-on fees upfront and potentially obtain positive profits from naive consumers in equilibrium. Our key contribution related to this literature is to show how different consumer protection policies affect equilibrium outcomes and efficiency when consumers make voluntary choices to purchase add-on products, i.e., when warranty contracts are disclosed to them as options at the point of sale.

Gabaix and Laibson (2006) give a bounded rationality explanation for why firms shroud the prices of add-on products in equilibrium. They develop a competitive model in which the purchase of a base product implies subsequent add-on costs. Sophisticated consumers foresee the add-on costs even without advertising and can substitute them. In contrast, myopes are unaware of these costs if information on add-on prices is shrouded. When the number of firms is sufficiently low, shrouding can persist in equilibrium.

Heidhues *et al.* (2014) build on the Gabaix and Laibson framework and show that when there exists a lower bound for base product prices, firms can earn profits by selling deceptive products to naive consumers, which can persist in equilibrium for any number of firms. When shrouding is costly, the deceptive shrouding equilibrium is unique. The authors provide several microfoundations for the lower bounds for add-on prices, such as adverse selection and consumer suspicion. From a modeling perspective, our model has the feature of Gabaix and Laibson (2006) with both sophisticated and naive consumers buying the same base products in equilibrium, and it contains lower price bounds as in Heidhues *et al.* (2014). Unlike both of these models, an add-on in our model is reflected not only by an additional potentially shrouded cost but also by a payment in case of product breakdown whose value is incorrectly predicted by naive consumers. This often makes it beneficial for firms to offer a menu of add-on products. Unlike in Gabaix and Laibson (2006), there is no extra effort cost in not choosing an add-on. This is reflected in consumers' ability to simply choose no extended warranty contract. Unlike Heidhues *et al.* (2014), both consumer types choose the same base product in equilibrium. This underlines the non-“deceptive” character of the base product.

In our companion paper Michel (2016), we show that when product quality is unobservable to consumers, a firm can offer lifetime warranties upfront together with strong exclusion fine print to profitably establish and exploit quality misperceptions among naive consumers.

Armstrong and Vickers (2012) study forms of add-on price regulation in a similar setting as Heidhues *et al.* (2014). With regard to banking regulation, the authors argue that adopting specific regulations such as overdraft warnings and hard budget constraints intended to help naive consumers may result in overall market inefficiencies. Ko and Williams (2013) further find that the combination of add-on price disclosure and sufficient add-on price caps weakly increases consumer welfare, while in isolation, the effects are ambiguous. Grubb (2015) develops a model in which the price that a consumer pays depends on his past usage, which is the case for many electricity and telephone contracts. Consumers are inattentive to past usage when making consumption decisions. When consumers anticipate their inattention under sufficient market competition, a bill-shock regulation can decrease consumer surplus, whereas it increases consumer surplus if they do not anticipate their inattention.

Inderst and Ottaviani (2013) study a relationship between a financial adviser and a private investor, and they show that granting a cancellation right to rational consumers who foresee the adviser's self-interest can make his cheap talk credible. If all consumers are "credulous," i.e., believe every piece of advice the seller gives them, then the seller always claims that a product is the most suitable for a consumer. The different modeling structures also yield important implications regarding the effectiveness of consumer protection policies. In their model, a sufficiently high minimum refund level in the presence of credulous consumers is both a consumer surplus and efficiency-enhancing tool, as it lowers the expected rents that the firm receives from false suitability claims. By contrast, in our model, such a policy can decrease efficiency because of the return costs and the interaction between both consumer types in a competitive environment.

Furthermore, the initial consumer neglect with respect to extended warranty prices when making a base product choice relates to the literature on context-dependent decision making and focusing, see for example Bordalo *et al.* (2012) and Kőszegi and Szeidl (2013). Bordalo *et al.* (2014) analyze a model of market competition in which strategic product positioning can affect the salience of different product features.

More generally, there is a growing body of literature on industrial organization models with a behavioral economics foundation; see Ellison (2006) and DellaVigna (2009) for broad literature reviews and the review of Armstrong (2008) for a summary of the consumer policy literature. DellaVigna and Malmendier (2004) show that when consumers are naive and have time-inconsistent preferences, firms deviate from marginal cost pricing to other pric-

ing structures to exploit the consumers' time inconsistencies. Armstrong and Chen (2009) develop a model in which some consumers do not pay attention to the quality component of products when making their purchasing decision under firm competition. In a symmetric mixed-strategy equilibrium, the existence of inattentive consumers is responsible for positive firm profits. Sandroni and Squintani (2007) analyze how behavioral biases affect a classic insurance model of asymmetric information. The authors show that if there is a high fraction of overconfident consumers, then a policy intervention in terms of minimum insurance is socially wasteful as a result of the detrimental effects on low-risk consumers.

The paper also relates to the literature on extended warranties in both law and industrial organization. Baker and Siegelman (2013) summarize the related law and economics literature with respect to extended warranties. Mann and Wissink (1990) assess the effectiveness of money-back and replacement warranties both when the product quality is observable and when it is not. The authors find that a money-back warranty is always better, except for an intermediate range of replacement costs for a firm. Lutz and Padmanabhan (1998) develop a model in which independent non-manufacturing firms can enter the market to sell extended warranties in the presence of a manufacturing monopoly. The effect on the manufacturer's profits is ambiguous.

6 Conclusion

In this paper, we analyze how different consumer protection policies affect market outcomes when retail firms can offer add-on insurance for their products. In our model, naive consumers' return cost misperceptions and the non-salience of warranties before a base product choice results in the profitability of extended warranty contracts at the point of sale. Under retail competition, this forces firms to sell a base product as a loss leader, from which sophisticated consumers benefit. Possible constraints on loss leadership, such as a no-arbitrage condition and retail price maintenance for the base product, can lead firms to retain some of the profits from selling extended warranty contracts.

The effectiveness of different consumer protection policies crucially depends on how they affect both the prices of extended warranties and the overall return costs incurred in the population. Our model yields the clear prediction that when possible, inducing competition for extended warranty contracts at the point of sale is the most favorable consumer policy because it leads retail firms to lower extended warranty prices down to the expected claim costs while avoiding increasing return costs in the population. While a minimum warranty level also decreases warranty contract prices, it results in increased social costs when lead-

ing sophisticated consumers to return faulty products in equilibrium. A policy that allows consumers to avoid extended warranty contracts increases consumer welfare but leads to a change in pricing only if there are no warranty return frictions in the population.

Our predictions are consistent with the effects of the introduction of policies that increase the competitiveness of the extended warranty market for consumer electronic products by UK legislators. One important empirical question for the future is whether the easy accessibility of independent insurers due to the internet, e.g., via smartphones, will translate into higher market shares. Recent evidence does not support this hypothesis: OFT (2012) reports that the largest UK independent insurance provider has only a 2 percent market share in the consumer electronics extended warranty industry, while almost 70 percent of the extended warranties are still sold at the point of sale. Furthermore, in many countries, amazon.com, as a leading retailer, only offers a single extended warranty provider for its electronic products, and consumers can buy such contracts only the same day on which they buy the base product.

A particular aspect of selling products over the internet is that the point of sale is virtual. If needed, introducing competition for add-on insurance at the point of sale could, for example, be induced via a common mandatory insurance comparison website that must be shown by each provider. However, problems of policy legislation arise for products that are sold by a single firm in different countries.

Finally, the industries in which add-on insurance is the most prevalent, such as retail markets for consumer electronics and both the low-cost airline and hotel industry, typically share a pattern of relatively low profit margins. This is consistent with our model in which the base products are sold as a loss leader. An open question in this case is whether the introduction of add-on insurance by these firms increases the competitiveness of the associated base product markets or is rather a response to an increased industry competitiveness itself.

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A Proofs

A.1 Proof of Proposition 1

The proof goes in several steps. In the first step we show that sophisticated consumers are never willing to pay more for an extended warranty than the firm’s expected warranty costs. Assume first that $\theta = 0$, i.e. only sophisticated consumers are in the market. For a specific warranty payment w , sophisticated consumers are willing to pay a maximum warranty price $x = (1 - q)F(w)E[w - r|w > r]$. The maximum difference between the expected warranty benefits for a consumer at quality level q , and the net warranty costs for a firm are $(1 - q) [F(w)(w - E[w - r|w > r])]$. Because sophisticated consumers fully anticipate the return costs of claiming a warranty payment, it follows that $w \geq E[w - r|w > r] \forall w > 0$. Thus, selling an extended warranty to sophisticated consumers never leads to positive firm profits. This implies that no warranty contract can lead to a higher joint surplus between

a firm and a sophisticated consumer than a costless 0 coverage default warranty contract that is by definition offered at a 0 cost. Since sophisticated consumers understand this fact and only observe an extended warranty contract after the base and the firm has no credible way to signal a default extended warranty contract with a positive coverage, they will always expect that a firm offers a 0 coverage default extended warranty contract $\gamma_0 = (x, w) = (0, 0)$ whenever $\theta = 0$.

In the second step we characterize the optimal menu of extended warranty contracts given that there are only naive consumers present, i.e. $\theta = 1$, and a firm has positive market share. Specifically, we show that no firm can do better than to offer a positive extended warranty contract that maximizes the difference between a naive consumer's predicted rent from the extended warranty contract and the expected claim costs next to a 0 coverage default contract $\gamma_0 = (x, w) = (0, 0)$. First notice that naive consumers do not pay attention to the extended warranty contracts before making a base product choice. Therefore, extended warranty contracts will not affect their base product choices. Because each firm has a quasi-monopoly at the point of sale, it can charge a naive consumer's full predicted willingness to pay for such a warranty, which leads to the extended warranty contract in equation (3). Given a 0 coverage default contract, any warranty level for a positive extended warranty contract that does not maximize this difference leads to a lower profit for any firm. Furthermore, any positive default contract in presence of only naive consumers weakly hurts a firm. This is because they do not take into account a positive warranty coverage when making a base product choice, but such a contract weakly reduces firm's profits from selling a positive extended warranty contract to naive consumers, and weakly increases the claim costs. Therefore, a firm can do no better than to offer a menu of extended warranty contracts $\Gamma = \{(0, 0), (\tilde{\pi}(q, \tilde{w}), \tilde{w})\}$ when only naive consumers are present.

In step 3 we show that the menu of extended warranty contracts $\Gamma = \{(0, 0), (\tilde{\pi}(q, \tilde{w}), \tilde{w})\}$ is also optimal whenever both consumer types are present, i.e. when $\theta \in (0, 1)$. For the same reasons as when $\theta = 1$, a firm's expected warranty profits are weakly decreasing in the default extended warranty coverage. Furthermore, also for the same reasons as when $\theta = 1$, each firm selling a base product to both consumer types can do no better than offering also a positive extended warranty contract (\tilde{x}, \tilde{w}) that is purchased by naive consumers. Because sophisticated consumers understand all this and no firm is able to credibly signal a default warranty contract with positive coverage, they will always believe that each firm offers a default extended warranty contract with zero coverage. It thus follows that there is no menu of extended warranty contracts leading to higher extended warranty profits than $\Gamma = \{(0, 0), (\tilde{\pi}(q, \tilde{w}), \tilde{w})\}$.

In step 4, we show that the equilibrium from the Proposition exists in which all firms set the same base price and menu of extended warranty contracts. Suppose first a firm has zero market share. Then it trivially makes zero profits. Suppose next that after setting a base product price p_i , retail firm i has a positive market share from both consumer types. Because consumers are locked in at the point of sale, it has a monopoly position for its consumers with respect to offering extended warranty contracts. Thus, as shown in step 3, it cannot do better than to offer a menu of extended warranty contracts $\Gamma = \{(0, 0), (\tilde{\pi}(q, \tilde{w}), \tilde{w})\}$, which generates a profit of $\tilde{\pi}(q, \tilde{w})$ per naive consumer. In case a firm i has zero market share, it always makes zero profits. In case it only has a positive market share from only one consumer type, there is also no menu of extended warranty contracts that leads to a higher profit. We show that given all firms set the menu of extended warranty contracts $\Gamma = \{(0, 0), (\tilde{\pi}(q, \tilde{w}), \tilde{w})\}$, the symmetric equilibrium in the Proposition exists, in which all firms set the same first stage prices and each product is purchased both by naive and sophisticated consumers. Each consumer chooses one of the firms with the lowest base product price equally likely, given that this price is equal or below the maximum willingness to pay Iq . Therefore, each firm with a positive market share faces both consumer types with the same proportion as in the whole population. Thus on average such a firm yields an expected profit $\theta\tilde{\pi}(q, \tilde{w})$ from selling a positive extended warranty contract per consumer. We next show that if $\theta\tilde{\pi}(q, \tilde{w}) < c$, in equilibrium at least two firms set a base product price $p_i = c - \theta\tilde{\pi}(q, \tilde{w})$. Suppose not and a firm sets a price below this level. This leads to expected losses, which cannot be an equilibrium strategy. Suppose not and that all firms have a price above this level. Then at least one firm can deviate by slightly undercutting the lowest price of its competitors to increase its profits. Therefore, the only equilibrium candidate that survives has all firms with positive market shares setting a price $p_i = c - \theta\tilde{\pi}(q, \tilde{w})$. Suppose next that $c \leq \theta\tilde{\pi}(q, \tilde{w})$. With a similar reasoning each firm in the market sets a base product price 0. Suppose not and one firm sets a base product price below 0. Then all consumers consume an unlimited amount of the base product without buying an extended warranty contract, which would lead to negative profits for this firm. Suppose not and that all firms set a base product price higher than 0. Then there always exists at least one firm that can profitably undercut the competitor with the lowest base product price. Therefore, the only equilibrium candidate that survives has all firms setting a price equal to 0. This completes the proof.

Proof of Proposition 2

We first show that at least two independent extended warranty providers offer an extended warranty contract $((1 - q)F(\tilde{w})\tilde{w}, \tilde{w})$. This follows from a simple Bertrand pricing argument. Each extended warranty provider only offers extended warranty contracts that lead at least to zero expected profits. Suppose now that all extended warranty providers set extended warranty contracts such that at least one firm makes positive profits while setting an extended warranty contract (x, w) , $w \neq \tilde{w}$. Then at least one firm can always profitably deviate by setting an extended warranty contract $(x - \epsilon, \tilde{w})$, for any arbitrarily small and positive ϵ . This is because \tilde{w} maximizes the predicted willingness to pay for an extended warranty contract minus the expected claim costs for a firm. But any profitable extended warranty contract with warranty level \tilde{w} will be undercut by a different firm. Therefore, if at least two firms set $((1 - q)F(\tilde{w})\tilde{w}, \tilde{w})$ and no other firm sets a contract that generates expected losses if it were the only firm in the market, no firm has an incentive to deviate. This leads to the equilibrium extended warranty contract $((1 - q)F(\tilde{w})\tilde{w}, \tilde{w})$. As in the proof of Proposition 1, the extended warranty profits are weakly decreasing in the default warranty coverage, therefore no firm can do better than offering a 0 coverage default extended warranty contract, which is what sophisticated consumers correctly predict. These results implies a zero expected profits from the extended warranty contracts for each retail firm. Therefore, price competition for the base product leads to base product prices equal to marginal costs, i.e. $p_i = c$ for each retail firm i in the industry. This completes the proof.

A.2 Proof Proposition 3

Given the minimum default extended warranty level w^{min} , $0 < w^{min} < \tilde{w}$ which a firm has to offer as a costless option to consumers, the optimal menu of extended warranty contracts by a firm change. Similar to Proposition 1, for each firm with a positive market share the extended warranty profits are still weakly decreasing in the default extended warranty level, which is why each firm optimally sets a default contract $(x, w) = (0, w^{min})$ under this regulation. This changes the incentive compatibility constraints for a firm making naive consumers purchase a positive extended warranty product. Compared to the case without minimum default warranty level the firm now has to give a rent $(1 - q)\tilde{F}(w^{min})\tilde{E}[w^{min} - r | w^{min} > r]$ to naive consumers for any positive extended warranty contract. The extended warranty profits for a firm selling a positive extended warranty contract with coverage $w > w^{min}$ to naive consumers, given that it faces both consumer types are thus $\theta\tilde{\pi}(w, q) - \theta(1 - q)\tilde{F}(\tilde{E}[w^{min} - r | w^{min} > r]) - (1 - \theta)(1 - q)F(w^{min})w^{min}$. But this results in the maximization problem

$\max_{w \in [w^{min}, \bar{w}]} \theta[\tilde{\pi}(q, w) - \tilde{\pi}(q, w^{min})] + (1 - q)F(w^{min})w^{min}$, which results in the same optimal warranty level \tilde{w} as in Proposition 1. By the definition of \tilde{w} and $w^{min} < \tilde{w}$, there is a solution to this problem. Similar to the proof of Proposition 1, a firm's profit is weakly decreasing in the default minimum warranty level, which sophisticated consumers anticipate. Therefore, each firm in equilibrium offers a menu of extended warranty contracts $\Gamma^{min} = \{(0, w^{min}), (\tilde{\pi}(q, \tilde{w}) - (1 - q)\tilde{F}(\tilde{w})\tilde{E}[w^{min} - r|w^{min} > r])\}$.

With an identical argument as in the proof of Proposition 1, in the base product pricing stage the price turns to $p^{min} = \max[0, c - \theta[\tilde{\pi}(q, \tilde{w}) - \tilde{\pi}(q, w^{min})] + (1 - q)F(w^{min})w^{min}]$. It follows that as long as $F(w^{min}) > 0$, naive consumers are strictly better off because of this policy. Sophisticated consumers' change in utility compared to no intervention is $-\theta\tilde{\pi}(q, w^{min}) + \pi(q, w^{min}) < 0$. Thus, if in absence of any intervention the equilibrium price is not binding at zero, it is sufficient for sophisticated consumers to receive a lower profit due to the minimum warranty level. The change in overall consumer surplus in this case is $-(1 - \theta)(1 - q)F(w)(w^{min} - E[w^{min} - r|w^{min} > r]) \leq 0$. If however the price without intervention is binding at zero and firms make positive profits, there are cases in which an intervention can decrease the expected warranty profits while still not be able to increase product prices. This does not affect sophisticated consumers' surplus while it increases naive consumers' surplus. However, if the base product price increases due to the intervention, the change in consumer surplus is negative for sophisticated consumers. This shows that a minimum warranty level weakly decreases sophisticated consumers' surplus. When the price is binding at 0 without regulation, a minimum expected warranty level increases consumer surplus whenever the decrease in firms' profit is bigger in absolute magnitude than the increase in the expected return costs that consumers face. This shows that the effects on overall consumer surplus are ambiguous. The change in overall welfare due to the intervention is $-(1 - \theta)(1 - q)F(w)(w^{min} - E[w^{min} - r|w^{min} > r]) \leq 0$, which implies that the policy weakly decreases overall welfare. This completes the proof.

Proof of Proposition 4

When $\tilde{w} = 0$ this holds trivially. We next look at the case when $\tilde{w} > 0$.

1. We first focus on the case in which $\beta < 1$. Specifically, we show that if $\beta < 1$, in equilibrium each retail firm i with positive market share sets a base product price $p_i = \max[0, c - \beta\theta\tilde{\pi}(q, \tilde{w})]$, together with a menu of extended warranty contracts $\Gamma_i = \{(0, 0), (\tilde{x}, \tilde{w})\}$, where \tilde{w} and \tilde{x} are defined by equation (3). All naive consumers buy an extended warranty contract (\tilde{x}, \tilde{w}) , while a fraction δ of them cancels their contract and instead switch to an independent extended warranty provider to buy a contract $\gamma_E = ((1 - q)F(\tilde{w})\tilde{w}, \tilde{w})$. We first show that

given that there is at least one retail firm that only offers positive extended warranty contracts $\gamma = (x, w)$ that are not equal $\gamma^{ind} \equiv ((1 - q)F(\tilde{w})\tilde{w}, \tilde{w})$ to consumers, and $\tilde{\pi}(w, q) \geq x$, for all of these contracts - i.e. they make no losses with these contracts - all independent extended warranty providers that sell a positive market share will always offer an extended warranty contract $\gamma = ((1 - q)F(\tilde{w})\tilde{w}, \tilde{w})$. This follows from the fact that a fraction $\beta > 0$ of naive consumers become aware of the different independent extended warranty contracts joint with a Bertrand pricing argument which is identical to that in the proof of Proposition 2. Therefore, given a firm sets an extended warranty contract $(x, w) \neq \gamma^{ind}$ with $\tilde{\pi}(q, w) \geq x$ that gets initially chosen by a naive consumer with positive probability, a fraction of β of these consumers cancel their contract because of becoming aware of the independent warranty providers' contracts and switching to these. Offering a contract (x, w) with $\tilde{\pi}(q, w) < x$ that gets chosen by naive consumers with positive probability is strictly dominated by offering only a default contract $(0, 0)$. Offering an extended warranty contract γ^{ind} next to a $(0, 0)$ default contract will yield to zero extended warranty profits. However, a fraction of $\theta(1 - \beta)$ consumers is not aware of the option to switch extended warranty contracts. But then it follows that firms maximize their extended warranty profits by offering the menu of extended warranty contracts $\Gamma = \{(0, 0), (\tilde{x}, \tilde{w})\}$ as in Proposition 1, which sophisticated consumers correctly anticipate. With a similar argument as in the Proposition it follows that all retail firms who have a positive market shares set a base product price $p = \max[0, c - \beta\theta\tilde{\pi}(q, \tilde{w})]$.

2. We next show, that if $\beta = 1$, in any equilibrium each retail firm i with positive market share sets a base product price $p_i = c$ and makes zero profits. All naive consumers will always buy a contract $\gamma = ((1 - q)F(\tilde{w})\tilde{w}, \tilde{w})$. From above it follows, that given a firm sets a positive extended warranty contract $(x, w) \neq \gamma^{ind}$, it will make a non-positive profit from it. Therefore, from a Bertrand pricing argument, base product competition will lead to $p = c$ for each product. From above it still holds that at least two independent extended warranty providers always offer an extended warranty contract γ^{ind} if at least one retail firm does not offer this contract and makes non-negative extended warranty profits, and furthermore these independent providers will never offer products for which they make losses on average. Therefore it follows that all naive consumers will end up buying an extended warranty contract γ^{ind} in equilibrium whenever $\beta = 1$. This completes the proof.

Proof of Corollaries 1 and 2 In text.

Proof of Corollary 3 We first prove point 1 of the corollary. If a firm unshrouds the menus of extended warranty contracts Γ given that all of its rivals does not unshroud the

warranty contracts, consumers become aware of a competitive extended warranty market. From Proposition 3 it follows that in this market independent insurance firms offer an extended warranty contract $\gamma_c = ((1 - q)F(\tilde{w})\tilde{w}, \tilde{w})$, and make zero profits. Therefore, a retail firm cannot make any positive profits when naive consumers are aware of the competitive insurance market, such that unshrouding the extended warranty contracts is not profitable.

We next prove point 2 of the corollary. If naive consumers become sophisticated via unshrouding of the menus of extended warranty contracts, their willingness to pay for an extended warranty go down to the sophisticated consumers' willingness to pay. From step 1 in Proposition 1 it follows that naive consumers who become sophisticated do not generate positive profits anymore, which leads to at most zero profits for a firm that unshrouds the extended warranty contracts. Therefore, given that none of its rival firms unshrouds the warranty contracts, a firm is never better off than when shrouding the naive consumers' return costs. This implies that the shrouding equilibrium always exists, and the equilibrium in Proposition 1 prevails. This is similar to Corollary 1 in Heidhues et al. (2014).

We next prove point 3 of the corollary. If consumers do not anticipate buying an extended warranty contract before going to a store even if warranty contracts are disclosed, they always buy a warranty from a retailer that sets the lowest base product price available, irrespective of the extended warranty contracts offered. Suppose firm i unshrouds all extended warranty contracts in the industry. Because naive consumers' demand and valuation of i 's base product are irrespective of the warranty levels offered in i 's menu of the extended warranty contract, Γ_i , it follows that no menu of extended warranty contracts can lead to higher extended warranty profits for firm i than the profit maximizing menu $\{(0, 0), (\tilde{x}, \tilde{w})\}$, where \tilde{w} and \tilde{x} are defined by equation (3) by the definition of this menu to be profit maximizing. But this implies that given at least one other firm j sets a base product price $p_j = \max[0, c - \theta\tilde{\pi}(q, \tilde{w})]$, firm i cannot make a higher profit from undercutting firm j 's price compared to setting base product price $p_i = \max[0, c - \theta\tilde{\pi}(q, \tilde{w})]$. If $p_j = 0$, undercutting it would lead to negative profits because of consumer arbitrage. If $p_j = c - \theta\tilde{\pi}(q, \tilde{w})$, for any lower price, all consumers buy the base product, while the firm cannot recoup the losses from the base product sales. Thus, unshrouding is again not profitable deviation for a firm, given that no other firm unshrouds its warranty contracts. This completes the proof.

B Alternative forms of consumer behavior and naivete

Hyperbolic discounting and projection bias Self-control costs due to hyperbolic discounting is one possible explanation for return costs in our model.¹⁸ If consumers have (β, δ) preferences under hyperbolic discounting, as in for example DellaVigna and Malmendier (2004), an overestimation of their short-term patience β yields an underestimation of the opportunity costs of returning a product. However, a purely hyperbolic model would have to imply naivete about self-control costs in each period in order to be able to predict a behavior of never returning a product. In any other case, there would be a last period in which returning the product to claim a warranty would be optimal. A second possibility is projection bias as in Loewenstein *et al.* (2003). If consumers return costs are low in a motivated state and high in an unmotivated state, under projection bias they underestimate the return costs they face in an unmotivated state while making a decision in a motivated state.

Risk aversion and loss aversion So far we have abstracted from risk aversion in our analysis. If consumers are risk averse, this increases their willingness to pay for an extended warranty. However, for positive firm profits to persist under this assumption in equilibrium, myopia with respect to not anticipating an extended warranty purchase before buying a base product is still required. Furthermore, several empirical studies show that pure risk aversion cannot account for the high markups of extended warranties in several consumer electronics industries. Jindal (2014) sets up a survey experiment to distinguish between risk-aversion and loss aversion of consumers with respect to extended warranty sales for washing machines. His calibrated model indicates that loss aversion is significantly more important in predicting consumer behavior than risk aversion. However, his experimental setup does not allow to test for return costs or any other return frictions. Huysentruyt and Read (2010) present experimental evidence that the magnitude of the feeling of loss in case of product breakdown is a more important purchase predictor for extended warranties than the attributed probability of product breakdown.

We next formalize a small model variant that incorporates reference-dependent loss aversion.¹⁹ Assume that naive consumers are initially myopic with respect to the possibility of buying an extended warranty. For simplicity, we abstract from all return costs and assume that sophisticated consumers are all risk neutral with respect to product breakdown. At the

¹⁸There is further evidence from both psychology and marketing suggests that a large fraction of consumers does not complain to producers after having experienced a product failure. The TARP (1996) study for example shows that conditional on having a service failure, more than 70 percent of the customers do not report it.

¹⁹See Köszegi and Rabin (2007) for a model of loss aversion and endogenous reference points.

point of sale, naive consumers form an exogenous reference point after making a purchasing decision with respect to the base product. This reference point is the average risk-neutral consumption utility given a base product price p and zero warranty, $Iq - p$. Define the reference dependent utility as $U^{RD}((x, w)|qI - p) = qU(I - x - p|qI - p) + (1 - q)U(w - x - p|qI - p)$. This setting is consistent with the interpretation of empirical results in Chen *et al.* (2009).²⁰ Due to loss aversion, consumers disproportionately suffer more from losses, i.e. product breakdown, than they benefit from gains. This increases their willingness to pay for an extended warranty contract that reduces the suffering in the breakdown period. A firm thus offers an extended warranty contract (x, w) that maximizes the difference between the reference dependent utility and the expected claim costs:

$$(x, w) \in \arg \max_{x, w} \tilde{\pi}^{RD}(q, w, x) = U^{RD}((x, w|qI - p) - (1 - q)w - U^{RD}((0, 0)|qI - p).$$

Whenever this profit is positive, this variant leads to a similar equilibrium as in our basic framework with observable product qualities, except for no cost frictions being present. Competition at the point of sale leads to the reference-dependent utility maximizing allocation subject to the constraint that firms make zero average profits. In terms of potential policy interventions, a minimum default extended warranty level weakly decreases the willingness to pay for a positive extended warranty contract, as it already increases the utility in the loss state. In case there are no cost frictions, the effects on overall welfare are different: any minimum warranty level is weakly beneficial for consumer surplus.²¹ In case of return frictions, the usual trade-off between lowering the prices of extended warranty contracts via a minimum warranty level and increasing social costs of return applies.

Exogenous quality misperceptions Another alternative assumption to the underestimation of return costs is that consumers exogenously overpredict the failure rate of a base product, and for simplicity do not incur any cost of product return. Huysentruyt and Read (2010) interpret survey evidence as consumers to initially overpredict product failure rates. In case sellers' sales techniques lead to overpredicting product failure at the point of sale, this increases the willingness to pay for extended warranties. If naive consumers do not anticipate buying an extended warranty contract before making a base product purchase, under retail competition the main results qualitatively hold compared to our baseline case.

²⁰Also see Sydnor (2010) for a discussion of the choice explanations for insurances against risks.

²¹Consumer surplus frictions could easily be incorporated using a known return cost distribution. An important normative question in an extended warranty context with loss averse consumers would be whether loss-aversion permanently affects consumer utility, or whether it can be temporarily induced by salesmen at the point of sale.