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A Survey of the Theory

of Warranty Contracts*

by

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Abstract

This paper surveys theories of the existence and design of warranty contracts. Insurance, signalling, and incentive motives are used to explain the existence of warranties. The incorporation of imperfections that prevent warranties from serving their basic purposes in a first-best way describes actual warranty practices.

Keywords: warranties, insurance, signalling, incentives, marketing

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I Introduction

Consumer product warranties are prevalent in many markets.¹⁾ Consumer durables, as well as some necessities and services are frequently sold in combination with some kind of warranty. In most countries the law implies a warranty of merchantability in all sales contracts, i.e. goods should do the job they are supposed to do. In the U.S. explicit warranties are mandated for all consumer products sold for more than fifteen dollars by the Magnuson-Moss Warranty Act of 1975. In spite of this prevalence, economists began only recently to study economic roles of warranties. In this paper we survey theories of the existence and design of warranties.

Warranties constitute a claim for the buyer on what a seller will do in the event of product failure. Accordingly, warranty contracts depend on the performance of the good in question. The contract can only be conditioned on characteristics of the good which are verifiable *ex post* by both parties to the contract as well as by the courts. If one contracting party cannot observe the characteristics the contract depends on, the warranty would be vacuous. The characteristics also must be verifiable by the courts to enforce the contract in case of disputes between seller and buyer.

Typically, the buyer receives nothing from the warranty contract if the good works satisfactorily. If the good shows any defect, the buyer gets the coverage which is promised in the contract. Warranties typically include replacement or repair of defective products, price refunds and sometimes include reimbursement for consequential damages. We will subsume under the term warranty the legal obligations that derive from a contract of sale as well as commitments which a seller undertakes in the form of an additional warranty contract, because we are only interested in the economic roles of warranties.

Warranties as defined above are thus distinct from service contracts and money-back guaranties. A service contract specifies that the seller just does the regular maintenance work such as lubrication etc. but has no other obligations. Accordingly, service contracts

do not depend on the product's performance. Money-back guaranties extend to a consumer who is merely dissatisfied with a working product the right to return the item. Under a warranty a bride may have defects in her wedding dress corrected. Yet she cannot return the dress simply because the groom cleared off. The latter is possible under a money-back guarantee²⁾.

The literature on warranties may be broadly classified as follows. One strand analyses warranties that make buying goods a less risky venture by providing either insurance or information. The second strand analyses warranties as a marketing strategy to extract consumer surplus. The main thrust of the first branch of the literature is to provide basic motives for the existence of warranties. The *insurance motive* is based on the assumption that buyers are more risk averse than sellers. With different attitudes towards risk, sellers provide buyers with insurance against the event of product failure in the form of warranty contracts. The *signalling motive* rests on the following idea. Several sellers offer a product at different, exogenously given quality levels. Buyers cannot discern the respective quality of an individual offer. Sellers use warranties as signals of the qualitative attributes of a product. Because a more reliable product incurs lower warranty cost, a producer can signal a high quality of his product by an extensive warranty coverage. The *incentive motive* for warranties is closely related to the signalling motive. The decision of firms which quality to produce is endogenous rather than exogenously given. The incentive motive views warranties as an incentive device for firms not to cheat on quality. By lowering the quality level, firms increase the probability of product failure and thereby incur higher warranty cost. Accordingly, warranties provide sellers with the incentive to supply high quality products.

In the following section we analyse the basic motives in detail. It will turn out that warranties may act as a signal of product quality or provide producers with the incentive not to cheat on quality and at the same time provide consumers with full insurance. To

understand the incomplete warranties that are prevalent in real world economies, in section III we describe theories which add additional incomplete information about the buyers' side to the basic motives for warranties.

In section IV we will look at the second branch of the literature which views warranties as a marketing device. The main thrust of these theories is to study warranties which serve to insure consumers as a strategic variable of firms with market power. We will analyse how warranties may be used by a monopolist to segment consumers with different tastes or different incomes. We will further describe the role of warranties as a surplus extracting device when consumers are uninformed about the price-warranty combinations available on the market.

Economic theories of warranties have been developed in the last decade or so. Before that, their analysis was mainly confined to law schools. In the concluding section we will briefly look at a theory which takes the existence of warranties as given and explains their design by the underlying market structure.

II Basic Motives for Warranties

In this section we will illustrate the different motives for warranties using a simple, unified model. Consider a one-commodity market with a large set of consumers who have initial income M . Consumers are interested in purchasing a single unit of the good in question. The commodity either works satisfactorily with probability $q \in (0, 1)$ or breaks down completely with probability $(1 - q)$. We will refer to the working probability q as the product's quality. A well functioning product generates a monetary value for consumers which is normalized to one. In case of product failure, consumers obtain a monetary warranty $w \geq 0$ ³⁾. Finally, let $p \geq 0$ denote the price for the product including the warranty. Then the consumers' expected utility is given as

$$V(q, p, w) = qU(M - p + 1) + (1 - q)U(M - p + w)$$

where the function $U(\cdot)$ with $U' > 0$ and $U'' \leq 0$ represents the consumers' risk preferences. Consumers seek to maximize their expected utility.

Firms produce any number of products of quality q at a unit cost $C(q)$ with $C' > 0$. Production cost are thus increasing in quality. Firms face no capacity constraints. A firm's expected profit per product is the price minus production cost minus expected warranty payments

$$\pi(q, p, w) = p - C(q) - (1 - q)w.$$

Firms are risk-neutral which means that they seek to maximize expected profits.

a) The Insurance Motive

The insurance motive is based on the idea that consumers are risk-averse whereas firms are risk-neutral. With different attitudes towards risk, sellers provide buyers with insurance against the event of product failure in the form of warranty contracts. In our

model consider the situation where the product's quality is fixed so that neither buyer nor seller exert any influence on q . Furthermore, the product's quality is commonly known. Consumers are risk averse, i.e. $U'' < 0$.

Let us analyse the situation without any warranty so that buyers bear the entire risk of product failure. The buyer's income is higher if the product works than his income if the product fails. Since the buyer's marginal utility decreases with income, his marginal utility in the bad state is higher than his marginal utility in the good state. Now consider the following transfer of income. Take δ units of income away from the good state and add $\delta q/(1 - q)$ units of income to the bad state. This transfer leaves the buyer's expected income unchanged. Yet, the loss in utility in the good state is smaller than the gain in utility in the bad state. Accordingly, this transfer of income raises the buyer's expected utility and he is willing to pay a price for it.

Consider now sellers. Sellers are risk neutral and maximize expected profits. Sellers do not care about any transfer of income which leaves expected profits unchanged. Therefore, sellers are willing to take over the income risk from buyers in the form of a warranty. Buyers gain from the transfer as long as their income in the bad state is lower than their income in the good state. Accordingly, sellers will insure buyers up to the point where their income is the same in both states, i.e. where $w = 1$.

Which side of the market appropriates the surplus from the efficient risk-sharing depends upon the market structure. If the seller is a perfect competitor, he has to offer a premium-benefit ratio which results in zero profits to have a clientele at all. If the seller is a monopolist, he will charge a premium-benefit ratio such that consumers are indifferent between buying and not buying the warranty contract. See Heal (1977).

To summarize, the description of a warranty as an insurance policy in a world with symmetric information predicts that warranties provide buyers with complete insurance $w = 1$, independent of the market structure⁴). See Figure 1.

insert: Figure 1

The insurance motive provides a good explanation of the various optional extensions to tied-in warranty agreements. These optional warranties cover e.g. transport charges or repairs in foreign countries. The separate offer, for a separate price, reduces the warranty premium tied to the sale of the basic product and may optimize the risk allocation. A British car buyer who declines to drive on the right may thus save on the warranty premium for coverage of repairs in continental Europe.

b) The Signalling Motive

Warranties as a signalling device are used to provide consumers with information about the quality of the product they intend to buy. Consider the situation where each firm produces one distinguished, exogenously given quality level. Consumers know the average quality of all firms. Yet they cannot identify the quality of an individual offer. In this situation, each producer has the incentive to claim top quality for his product. Rational consumers, however, have to ignore such statements. Accordingly, the products are identical for consumers and will be traded at an average price which reflects average quality. This average price may not cover the production cost of high quality products. High quality producers stop offering their products. The range of quality levels offered worsens; good products are driven out of the market by bad products. Rational consumers will take this kind of producer behaviour into account. They will no longer base their decision on the average quality of all potential producers, but on the average quality of those firms which actually offer the product. This kind of consideration lowers the price consumers are willing to pay. Those high quality producers who still offered their product at the average price reflecting the average quality of all potential firms may now opt to stop selling their product. Accordingly, even more good products are driven out of the market. This informational asymmetry may even result in market break-down. See Akerlof (1970).

A solution to this adverse selection problem consists in firms sending credible signals of product quality. If high quality producers send signals which are too costly to be imitated by low quality producers, then rational consumers can infer from the observation of these signals that the products must be high quality ones. Assume that in our model some firms produce a high quality level q_H while the other firms produce a low quality level q_L . Since $q_H > q_L$, a high quality producer can offer an additional unit of warranty at a lower cost than a low quality producer. See Figure 2.

insert: Figure 2

If high quality producers offer a warranty $w > \bar{w}$ at the fair-odds rate $(1 - q_H)$, a low quality producer mimicking this signal would incur losses, because the failure probability of his product is higher. Therefore, low quality producers prefer to stay out of the market. If firms are perfect competitors and consumers are risk neutral, i.e. $U'' = 0$, in equilibrium only high quality producers offer their product with any warranty $w > \bar{w}$ at the fair premium-benefit ratio $(1 - q_H)$. Warranties serve only a signalling purpose. If consumers are risk averse, i.e. $U'' < 0$, firms offer the complete warranty $w = 1$. Warranties then serve both, signalling and insurance motives. See Grossman (1981).⁵⁾

c) The Incentive Motive

The incentive motive for warranties is closely related to the signalling motive. The decision of firms about which quality to produce is endogenous rather than exogenously given. Assume that in our model all firms have the same technology $C(q)$ which allows them to produce either a high quality q_H or a low quality q_L . Firms maximize profits with respect to quality. In the absence of warranties, firms set quality to the low value q_L , because they incur lower production cost. Prosser (1943) has pointed out that many manufacturers would provide consumers with 'worthless junk' if there were no judicial

intervention that implies 'warranties of quality'.

If the product is sold with a warranty, firms face the following trade-off: On the one hand, cheating on quality means lower production cost. On the other hand, cutting the quality level leads to higher warranty cost. Therefore, warranties penalize such behaviour on the part of firms. See Figure 2. If firms offer a warranty $w > \bar{w}$, they make higher profits if they produce the high quality q_H instead of q_L . Therefore, whenever consumers observe a warranty $w > \bar{w}$, they know that they face a high quality product because firms have no incentive to cheat on quality. See Spence (1977).

The role of warranties as a device to provide consumers with information may be summarized as follows. Without warranties it is high quality products which get driven out of the market. With warranties it is low quality products. This ability has substantially influenced consumer product warranty policy⁶). The objective of the 1975 Magnuson-Moss Warranty Act is to make warranties more efficient for this purpose. The act requires manufacturers to draft warranties in a simple and readily understood language. All important provisions should be conspicuous. Warranties have to be available for consumer inspection prior to purchase so that consumers can infer the quality level of the good in question.

The insurance, signalling, and incentive motives are a sound basis to explain the existence of warranties. We have seen that warranties nicely serve all three purposes. They may provide consumers with full insurance and at the same time act as a signal of product quality or provide producers with the incentive not to cheat on quality. Yet, these basic motives are not able to explain the variety of warranty practices which can be found in real world economies, such as limited warranty coverage, limited warranty duration, or interfirm differences in warranties. To understand these phenomena one has to invoke imperfections which prevent warranties from serving for the basic motives in a first-best way.

The theories we will describe now try to explain such phenomena. They all rely on

at least one of the basic motives. We have classified them somewhat arbitrarily as follows. In section III, we look at models where competitive firms offer warranties. Incomplete information about the buyers' side prevents warranties from serving the basic motives in a first-best way. In section IV, we describe models where frictions arise from firms with market power which use warranties to extract consumer surplus.

III Moral Hazard and Adverse Selection

It is reasonable to suspect that incomplete information about the buyers' side forms a clue to the understanding of incomplete warranties. It is well known from the insurance literature that moral hazard and adverse selection problems may prevent efficient risk-sharing. Adverse selection problems arise when there is incomplete information about the attributes of those who purchase insurance. Changing the terms of the insurance contract affects the mix of those who apply for insurance. Moral hazard problems arise when there is imperfect information concerning the actions of those who purchase insurance. The more insurance individuals get, the less incentive they have to take appropriate actions.

a) Moral Hazard

The so called investment theory of warranties (McKean (1970), Oi (1973), Priest (1981)) is based on this kind of moral hazard problem. In our model consider the situation where the product's quality is common knowledge and cannot be influenced by firms. Yet, in the way they handle the product, risk-averse consumers can influence the probability of product failure. The more effort consumers invest, the lower is the probability of product failure. But effort is costly. If $e \geq 0$ denotes the effort level, the consumers' expected utility may be written as

$$V(q, p, w, e) = q(e)U(M - p + 1) - (1 - q(e))U(M - p + w) - e$$

where $q' > 0$. Consumers face the following trade-off. On the one hand, an increase in the effort level raises the consumers' expected utility by lowering the break-down probability. On the other hand, an increase in the effort level lowers the consumers' expected utility because effort is costly. To explain the consumers' optimal choice of effort, consider the difference in utility between a working and a failing product $\Delta U = U(M - p + 1) - U(M - p + w)$. By raising his effort level, a consumer gains $q'(e)\Delta U$. Effort is set optimally when this marginal benefit outweighs marginal cost, i.e. $q'(e)\Delta U = 1$.

A moral hazard problem arises when producers providing warranties cannot monitor the consumer's choice of effort. Having bought the product, a consumer picks his effort level in a way which is individually optimal. Suppose firms provide the complete warranty $w = 1$ so that $\Delta U = 0$. In this situation, a consumer has no incentive to invest in effort. He sets effort to its minimum value so that the failure probability of the product is at its maximum level. In order to avoid losses, firms have to charge the premium-benefit ratio $(1 - q(0))$.

If this outcome is not socially desirable, a trade-off between efficient risk-sharing and providing incentives for choosing appropriate private actions arises. If firms offer less than a complete warranty, the utility of having a working product becomes larger than the utility of a failing one. Therefore, it becomes worthwhile for consumers to invest in effort. Warranty coverage is set optimally when the marginal losses in risk-sharing equal the marginal benefits in providing the appropriate incentives.

The investment theory which combines the insurance motive with a consumer moral hazard problem, thus explains warranties which provide less than full insurance. The investment theory has been extended to the case in which warranties serve for the insurance and the incentive motive in the presence of consumer moral hazard. See Emons (1988)⁷). Again warranty coverage has to be rationed to induce consumers to provide high effort so that there are welfare losses due the inefficient risk-sharing. If these rationed warranties are

large enough to induce firms to produce high quality, the market outcome is second-best optimal. If the consumer moral hazard problem is so severe that the rationed warranty coverage is too small to induce firms not to cheat on quality, then the outcome is inefficient and may even result in market break-down. Equilibrium warranty coverage may be positively or negatively correlated with the quality level, a result which might coincide with empirical observations.⁸⁾ Adding a consumer moral hazard problem to the basic motives for warranties thus turns out to be useful in explaining limited warranty coverage.

b) Adverse Selection

It is a well known from the insurance literature that adverse selection problems may result in a rationed indemnity. See Rothschild and Stiglitz (1976) and Wilson (1977). In our model consider the situation where the product's quality is commonly known and cannot be influenced by firms. Producers face two groups of risk-averse consumers: low-risk consumers with fraction $\lambda \in (0, 1)$ of the population and high-risk consumers with fraction $(1 - \lambda)$, respectively. Due to exogenously given differences in the consumers' characteristics, the product's break-down probability when it is used by low-risk consumers, $(1 - q_l)$, is lower than the failure probability $(1 - q_h)$ when it is utilized by high-risk consumers. If firms can perfectly discriminate between the two groups, they will offer warranty coverage at the premium-benefit ratio $(1 - q_l)$ for low-risk consumers and at the fair odds rate $(1 - q_h)$ for high-risk consumers. If firms cannot discriminate, high-risk consumers will try to purchase the cheap warranty contract designed for low-risk consumers. Two outcomes may arise under these circumstances. See Figure 3.

insert: Figure 3

In a pooling situation, firms offer the warranty at the average break-down probability $(1 - \bar{q}) = \lambda(1 - q_l) + (1 - \lambda)(1 - q_h)$. Low-risk consumers choose the warranty level

w_p which is less than complete because the premium-benefit ratio $(1 - \bar{q})$ is unfair for this group. High-risk consumers also buy this warranty level in order not to reveal their identity. In a separating situation, firms offer two distinct contracts. High-risk consumers purchase the complete warranty $w = 1$ at their fair odds rate $(1 - q_h)$. Low-risk consumers purchase the warranty level $w_o < 1$ at their fair odds rate $(1 - q_l)$, where the rationed warranty w_o is constructed such that high-risk consumers have no incentive to purchase this cheap contract for low-risk consumers. Since high-risk consumers face a higher breakdown probability than low-risk consumers, they care more about insurance and rationing the indemnity can be used as a self-selection device.

Accordingly, under adverse selection circumstances we observe the following two market outcomes. In a pooling situation, all consumers buy the same warranty contract and the amount of warranty w_p is less than complete because the premium-benefit ratio $(1 - \bar{q})$ is unfair for low-risk consumers. In a separating situation, high-risk consumers purchase the complete warranty $w = 1$ at their fair odds rate $(1 - q_h)$. Low-risk consumers purchase a warranty level $w_o < 1$ at their fair odds rate $(1 - q_l)$; w_o is rationed so that high-risk consumers prefer to purchase the contract designed for them.

This adverse selection phenomenon has also been used to explain limited warranty duration rather than limited warranty coverage. Consider the setup where firms offer a product with a stock of services which consumers exhaust over time. High-risk consumers use the product at a higher intensity than low-risk consumers. Therefore, high-intensity users have exhausted total capacity at some point in time at which low-intensity users are still utilizing the product. Firms cannot distinguish between the two groups nor can they determine whether a product failed because it was worn out by a high-intensity user or because an unlucky low-intensity user experienced a random failure. Although in a pooling and a separating situation low-intensity users can obtain a warranty duration equal to their product's lifetime, they may prefer a limited warranty duration under both circumstances.

Limited warranty duration means that low-intensity users bear the risk of product failure alone for the last period of product life. See Emons (1989). Adverse selection phenomena are thus able to explain not only limited warranty coverage but also the limited warranty duration which is generally observed.

IV Warranties as a Marketing Device

In this section, we will illustrate warranties as a marketing device to extract consumer surplus. We will describe how warranties have been incorporated into the theory of monopolistic consumer discrimination and the theory of price dispersion. The basic motive for warranties in these extensions is to insure risk-averse consumers. These theories analyse to what extent this motive can be exploited by firms with market power⁹⁾.

a) Monopolistic Consumer Discrimination

In Section II a) we have seen that a risk-neutral monopolist will provide risk-averse consumers with a complete warranty. If the monopolist faces different risk-averse consumers and cannot engage in direct price discrimination, he may use warranties as a device to segment consumers. The monopolist's discrimination problem has been analysed for the case where consumers have different preferences for the product as well as for the case where consumers have identical taste but the preference for insurance increases with income. Both approaches result in the phenomenon that a product is offered with a variety of warranty contracts. The different terms in the contracts serve the purpose of segmenting consumers and thereby extract consumer surplus.

Let us first look at the situation where consumers vary in taste. In our model consumers vary by the monetary amount that they value a working product. Consumers cannot observe the monopolist's quality. Warranties thus serve both, the insurance and incentive motives. The monopolist knows the general distribution of tastes but cannot

distinguish among buyers prior to an actual sale. Therefore, the monopolist cannot engage in direct price discrimination. Discrimination is limited to what can be achieved by the self-selection of consumers among a price-warranty schedule¹⁰). The profit maximizing price, warranty, and quality combinations that the monopolist chooses, subject to the constraint that all types of consumers are allowed to choose from the same schedule have the following properties. All consumers except the one with the highest willingness to pay get quality and warranty levels which are less than what is socially efficient. The monopolist provides less than the efficient quality and warranty level to consumers with a low valuation to discourage high demand buyers from switching to low margin products¹¹). If legislation requires money-back warranties for all products, this will increase the quality of the low tier product if the monopolist continues to sell it. Yet such a law decreases social welfare if the seller opts to stop distributing the product. This occurs when the improved low quality product becomes too attractive to buyers of the high quality products. See Holmes (1984).

If a monopolist faces risk-averse consumers with identical taste but different incomes such that rich consumers have a higher preference for insurance than poor consumers, then the following strategy is superior to pure monopoly pricing. The monopolist offers the product at a low price without any warranty and at a high price with a warranty which replaces defective units free of charge. The warranted product is bought by rich consumers whereas the unwarranted product is bought by poor consumers. With this optional pricing strategy, the monopolist extracts more consumer surplus than with pure monopoly pricing. See Kubo (1986).

Warranties as a marketing device for a monopolist to segment consumers thus explain the phenomenon that top of the line products come with a more extensive warranty than economy versions. The different warranty terms serve the purpose of consumer self-selection so that the seller extracts more surplus than with pure monopoly pricing. An

obvious example is the automobile market in which new cars typically come with a warranty whereas it is often difficult to get a warranty on used cars. The airline passenger market provides another example. When first-class passengers are bumped, they receive a ticket for a later flight plus additional compensation. When standby passengers are denied boarding, they receive no compensation. An alternative explanation for distributions of warranty contracts is provided by the search approach.

b) Search and Price-Warranty Distributions

It has been widely observed that the Law of the Single Price does not hold for many markets. The literature on price dispersion explains this phenomenon by the different information consumers have about the distribution of offered prices¹²⁾. Schwartz and Wilde (1983) extend this approach to include warranties which serve to insure consumers¹³⁾. Consider the setup of our basic model. Firms offer the product with or without a replacement warranty. Risk-averse consumers do not know which firms offer which price-warranty combinations. They can get informed by visiting an exogenously given number of firms. Consumers do not exchange any information. There are two groups of consumers. Nonshoppers visit only one firm whereas shoppers visit at least two firms. If there are enough shoppers, in equilibrium all firms offer the product including the warranty at competitive prices. If one firm unilaterally increases its price or stops offering the warranty, on the one hand it would earn more from nonshoppers. On the other hand, the firm would lose all shoppers. Such a deviation is not attractive if there are enough shoppers. If there are not enough shoppers to support this equilibrium, some firms have market power and exploit nonshoppers. If firms earn more from nonshoppers when charging their limit price for the product with warranty than charging the limit price for the product without warranty, in equilibrium all firms offer the replacement warranty. At least some firms charge supra-competitive prices. In the opposite case some firms offer the product without warranty at

supracompetitive prices.

Accordingly, the fact that consumers are uninformed about the offers on the market may result in the product being offered both with and without warranty. Firms which exploit nonshoppers do this by supplying the product without a warranty. Search models thus provide an alternative explanation for the distributions of warranties.

V Conclusions

In this paper, we have summarized recent work on warranty contracts. At this point, it is appropriate to mention the first approach to explain the design of warranties, dating back to Kessler (1943). The so called exploitation theory takes the existence of warranties as given and explains their design by the market power of manufacturers. According to this theory standardized warranty contracts are drafted unilaterally by the seller and only involuntarily adhered to by the consumer. Following Kessler, standardized contracts are typically used by sellers with strong market power. The consumer, in need of the goods, is frequently not in a position to shop around for better terms either because the seller has a monopoly or because all competitors use the same clauses. The seller possesses 'unfettered discretion' to incorporate terms that serve his interests because his bargaining position is superior to that of the consumer.

It follows from the exploitation theory that sellers will limit their obligations to consumers as far as possible. If collusion is widespread, warranty contracts within individual industries are likely to be similar. More recent statements of the theory emphasize the marketing power gained from combining advertising that makes extraordinary promises with warranties that disclaim responsibility for the promises.

The exploitation theory found wide acceptance because it was the only approach to standardized warranty contracts until the 1970s. The theory seems to be consistent with case histories of warranty practices.¹⁴⁾ The theory substantially influenced courts which henceforth refused to enforce exploitative elements of standardized warranty contracts.

Nevertheless, the theory does not provide any explanation why warranties exist at all. Therefore, it is unclear why warranties can serve exploitative ends. If the seller disclaims promises in the warranty contract, rational consumers will ignore these promises beforehand. As a marketing device the warranty contract is ineffective and cannot actually serve to exploit consumers. One has to assume irrational consumer behaviour to explain exploitation with warranties that disclaim responsibility. We have described several ways that binding warranties can be used as a strategic variable of firms with market power. Accordingly, if the seller can sign binding warranties, he extracts more surplus from rational consumers than with contracts that disclaim responsibility.

In summary we may conclude that during the last decade the economic theory of warranties has profited greatly from the development of models with incomplete information and moral hazard. The insurance, signalling and incentive motive all provide good reasons for the existence of warranties. The incorporation of countervailing effects which are due to incomplete information about the buyers' side provides several competing explanations as to why most actual warranties are incomplete. Warranties as a marketing device to extract consumer surplus explain the phenomenon that a product is offered with a variety of warranty contracts. It is interesting to see whether warranties can also be used as a device to maintain producer surplus. For example, service warranties may require a large dealer network which might be expensive to set up. Under these circumstances, warranties might serve as a barrier to entry.

Throughout the paper we have set aside reputational arguments. Reputation may act as a substitute for warranties as a signalling or incentive device. Without any warranty, a producer may find it advantageous not to cheat on quality in order to maintain a reputation for high quality¹⁵). Analysing the role of warranties as a signalling or incentive device in a market where reputation might serve the same purposes remains an interesting topic for future research.

At the moment, there is a paucity of empirical work investigating which particular theory is best suited to describe actual warranty policies. Priest (1981) examines whether the exploitation, signalling or investment theory best explains the content of 62 consumer product warranties. A comparison alone cannot provide sufficient grounds to accept or reject any of the theories. Nevertheless, Priest finds some suggestion that among the three theories under study the investment theory is best suited to explain the actual design of warranties.

Footnotes

- 1) Priest (1981) even claims that warranties are the most common of written contracts.
- 2) Lutz (1985) defines any contract that is optional as a service contract. An optional contract specifying that the labour costs necessary to repair the good are borne by the manufacturer is an optional warranty according to our definition and a service contract according to Lutz's definition. See Mann and Wissink (1986) for an analysis of money-back guaranties.
- 3) In our model the product's contingencies are measured in monetary units. Therefore, the different warranty coverages that are mentioned in the Introduction can be expressed in terms of the monetary warranty w . Throughout this paper we will assume that no disputes arise about whether a product is defective or not. See Palfrey and Romer (1983) for a discussion of possible dispute resolution mechanisms.
- 4) In a multiperiod framework, Brown (1974) shows that the warranty duration equals the lifetime of the product.
- 5) Gerner and Bryant (1981) incorporate an information processing cost to consumers in a framework where warranties act as signals. Consumers purchase durables only occasionally. The cost of understanding a specific warranty contract is high. Therefore, warranty terms across different markets should be similar, each taking advantage of the greater benefit to consumers of general rather than specific information. Wherever warranty terms diverge from the near-uniform standards of most warranties, the divergent terms will offer coverage more generous than the uniform terms. Subordinate terms of a warranty are likely to diverge from the norm and offer relatively more restrictive coverage. Gerner and Bryant empirically investigate the content of 108 warranties of various consumer durables. Their findings offer mild support for their allegations.
- 6) See Priest (1981).
- 7) See Cooper and Ross (1985) for an analysis of such a double sided moral hazard problem

with risk neutral consumers. See Lutz (1985) for an analysis of warranties which serve the insurance and signalling motives in the presence of consumer moral hazard.

8) Cooper and Ross (1985) derive a similar result and give as an example of negative correlation the U.S. automobile market. In this market, Japanese manufacturers sell cars of higher quality than domestic producers, but with inferior warranty protection. In West Germany, most of the future rust-heaps come with an extensive warranty against corrosion whereas Mercedes Benz, Saab, and Volvo, by all accounts among the least rust-prone brands, provide no such warranty at all. Yet, I am reluctant to use double moral hazard models to explain these observations. First, these models analyse markets where products differ in their working probability but are otherwise homogeneous. Second, the correlation results are of comparative statics nature, i.e. in equilibrium there is no coexistence of different quality levels. Third, there seem to be strong reputational effects in automobile markets which are not captured by the theories.

9) In an interesting paper, Braverman, Guasch and Salop (1983) establish another motive for the provision of warranties. They show that an optional warranty that serves neither insurance, signalling nor incentive purposes can be used by a monopolist to effect a two-part tariff, i.e. act as an entrance fee into the market.

10) See Matthews and Moore (1987) for an analysis of the situation where consumers can observe quality so that the monopolist has to solve an intricate three dimensional screening problem.

11) This is analogous to the result by Mussa and Rosen (1978) where quality could be observed directly by consumers.

12) See e.g. Salop and Stiglitz (1977) and Varian (1980).

13) See also Wilde and Schwartz (1979) for a formal analysis of the model without warranties.

14) See Priest (1981) and the references quoted therein.

15) See Shapiro (1983).

References

- AKERLOF, G. (1970): The Market for 'Lemons': Quality Uncertainty and the Market Mechanism, *Quarterly Journal of Economics*, 84, 488 - 500.
- BRAVERMAN, A., GUASCH, J.L. and SALOP, S. (1983): Defects in Disneyland: Quality Control as a Two-Part Tariff, *Review of Economic Studies*, 50, 121 - 131.
- BROWN, J.P. (1974): Product Liability: The Case of an Asset with Random Life, *American Economic Review*, 64, 149 - 161.
- COOPER, R. and ROSS, T.W. (1985): Product Warranties and Double Moral Hazard, *Rand Journal of Economics*, 16, 103 - 113.
- EMONS, W. (1988): Warranties, Moral Hazard, and the Lemons Problem, *Journal of Economic Theory*, forthcoming.
- EMONS, W. (1989): On the Limitation of Warranty Duration, *Journal of Industrial Economics*, forthcoming.
- GERNER, J. and BRYANT, K. (1981): Appliance Warranties as a Market Signal, *Journal of Consumer Affairs*, 51, 75 - 86.
- GROSSMAN, S.J. (1981): The Informational Role of Warranties and Private Disclosure about Product Quality, *Journal of Law and Economics*, 24, 461 - 483.
- HEAL, G. (1977): Guaranties and Risk-Sharing, *Review of Economic Studies*, 44, 549 - 560.
- HOLMES, T.J. (1984): "Monopoly Bundling of Warranty and Product Quality when Quality is Unobservable", CMSEMS Discussion Paper No. 612s, Northwestern University, Illinois.
- KESSLER, F. (1943): Contracts of Adhesion - Some Thoughts about Freedom of Contract", *Columbia Law Review*, 43, 629 - 643.
- KUBO, Y. (1986): Quality Uncertainty and Guarantee - A Case of Strategic Market Segmentation by a Monopolist, *European Economic Review*, 30, 1063 - 1079.
- LUTZ, N. (1985): "Discrete Warranties, Signalling and Consumer Moral Hazard", mimeo, Graduate School of Business, Stanford University.
- MANN, D.P. and WISSINK, J.P. (1986): "Money Back Guaranties", mimeo, Cornell University, Ithaca, New York.
- MATTHEWS, S. and MOORE, J. (1987): Monopoly Provision of Quality and Warranties: An Exploration in the Theory of Multidimensional Screening, *Econometrica*, 55, 441 - 467.
- MCKEAN, R. (1970): Products Liability: Implications of some Changing Property Rights, *Quarterly Journal of Economics*, 84, 611 - 626.
- MUSSA, M. and ROSEN, S. (1978): Monopoly and Product Quality, *Journal of Economic Theory*, 18, 301 - 317.
- OI, W. (1973): The Economics of Product Safety, *Bell Journal of Economics*, 4, 3 - 28.
- PALFREY, T. and ROMER, T. (1983): Warranties, performance, and the Resolution of Buyer-Seller Disputes, *Bell Journal of Economics*, 14, 97 - 117.
- PRIEST, G. (1981): A Theory of the Consumer Product Warranty, *Yale Law Journal*, 90, 1297 - 1352.
- PROSSER, W.L. (1943): The Implied Warranty of Merchantable Quality, *Minnesota Law Review*, 27, 117 - 168.

- ROTHSCHILD, M. and STIGLITZ, J.E. (1976): Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information, *Quarterly Journal of Economics*, 90, 659 - 679.
- SALOP, S. and STIGLITZ, J.E. (1977): Bargains and Ripoffs: A Model of Monopolistically Competitive Price Dispersion, *Review of Economic Studies*, 44, 493 - 510.
- SCHWARTZ, A. and WILDE, L.L. (1983): Imperfect Information in Markets for Contract Terms: The Examples of Warranties and Security Interests, *Virginia Law Review*, 69, 1387 - 1485.
- SHAPIRO, C. (1983): Premiums for High Quality Products as Returns to Reputation, *Quarterly Journal of Economics*, 97, 659 - 679.
- SPENCE, M. (1977): Consumer Misperceptions, Product Failure and Producer Liability, *Review of Economic Studies*, 44, 561 - 572.
- VARIAN, H.R. (1980): A Model of Sales, *American Economic Review*, 70, 651 - 659.
- WILDE, L.L. and SCHWARTZ, A. (1979): Equilibrium Comparison Shopping, *Review of Economic Studies*, 46, 543 - 554.
- WILSON, C. (1977): A Model of Insurance Markets with Incomplete Information, *Journal of Economic Theory*, 16, 167 - 207.

FIGURE 1: Efficient risk-sharing requires the complete warranty $w=1$
(depicted for a competitive market).

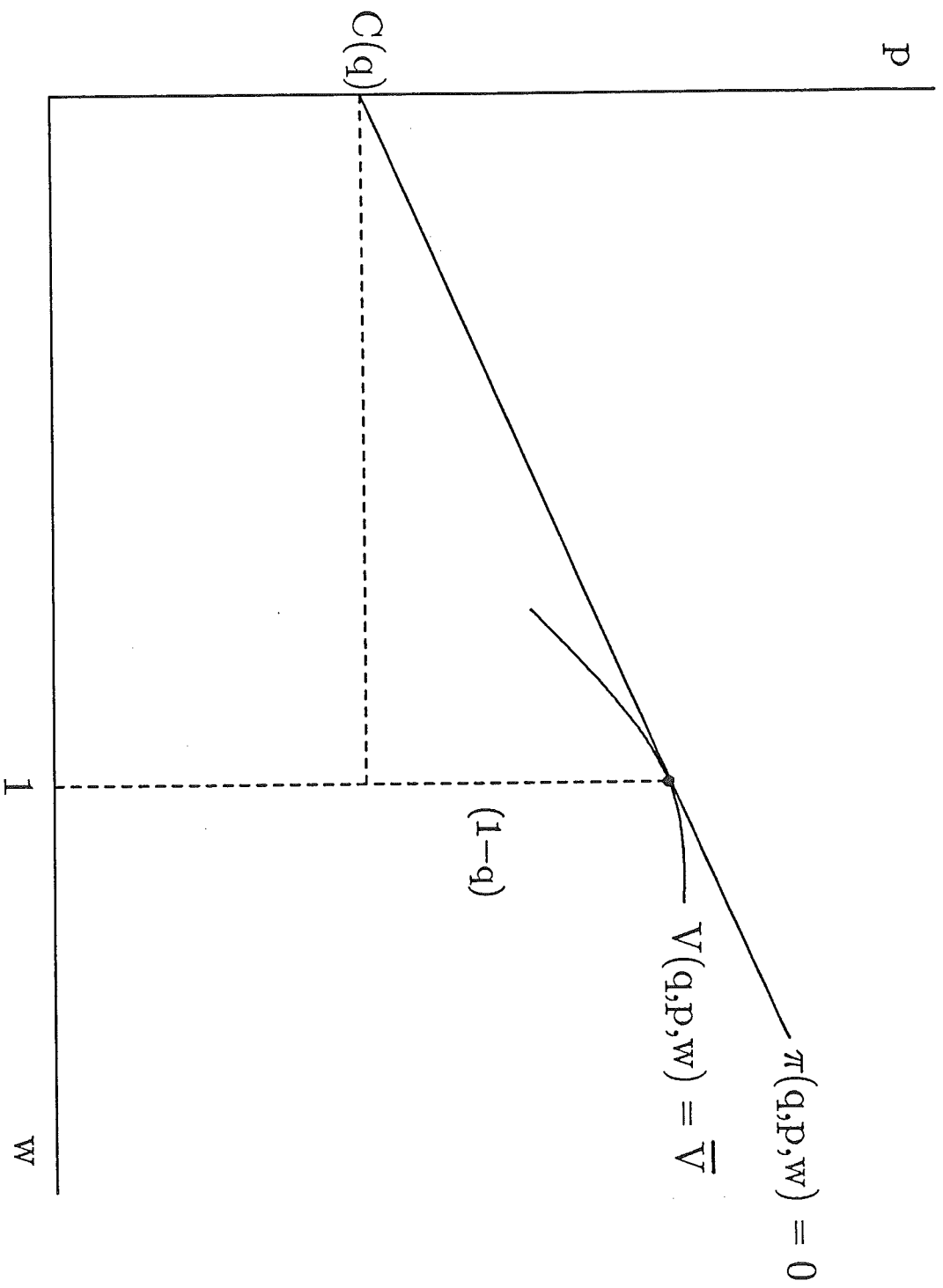


FIGURE 2: Warranties as a device for providing information about product quality.

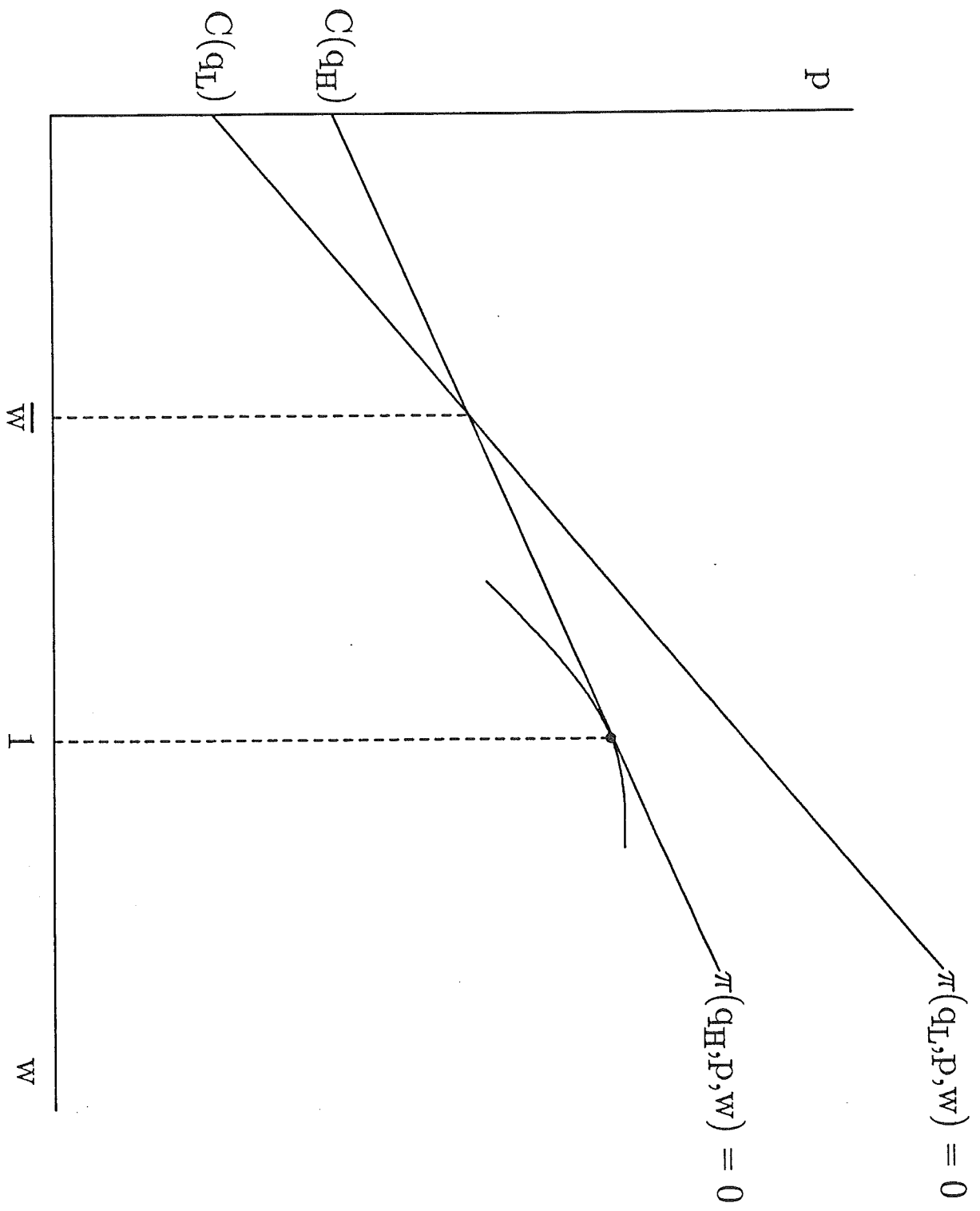


FIGURE 3: Warranties as an insurance device in the presence of adverse selection results in a limited coverage for low-risk consumers.

