

12-6-2006

Unraveled: The Failure of Products Liability Markets

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Recommended Citation

Fluhr, Michael J., "Unraveled: The Failure of Products Liability Markets" (2006). *Harvard Law School Student Scholarship Series*. Paper 9.

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UNRAVELED: THE FAILURE OF PRODUCTS LIABILITY MARKETS

Michael J. Fluhr^{*}

Conventional law and economics wisdom suggests that efficiency is served by allowing purchasers of goods to waive strict liability. Intuition suggests that where purchasers can bear risk of product defects more cheaply than can sellers and manufacturers, laws should permit them to do so. However, even rational and completely informed buyers are vulnerable to a market failure, which this Article dubs “unraveling,” that may cause all buyers to successively waive strict liability even though it may be more efficient ex ante if they did not. This Article explains, models, and explores this unraveling phenomenon. It distinguishes the markets in which unraveling is likely to occur and concludes by suggesting rules and methodologies for pinpointing and preventing unraveling.

^{*} J.D., Harvard Law School, 2006.

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Introduction

Law and Economics scholars have long railed against the rule in most jurisdictions that buyers cannot waive their right to hold sellers strictly liable for personal injury caused by defective products. Economic instinct entices them to assume that allowing buyers to waive strict liability in return for some quid pro quo is desirable since buyers can rationally judge for themselves the value of strict liability to them; the government should not prevent such an efficient transaction.. The underlying reasoning is that buyers should be able to waive when they are in a better position to bear this risk better than the seller. To an economist, a legal barricade to such efficient market transactions is the sin of sins.

Critics of a waiver regime have focused on possible failures of a market for risk, such as buyer ignorance or disparity in bargaining power, but those in the waiver camp have parried convincingly, demonstrating that a waiver regime leads to efficiency anyway since these market failures are negligible. Still the argument for waiver has a hidden heel of Achilles. The argument for allowing waiver fails to acknowledge that buyers are individuals. They vary widely in predisposition to risk, based on traits such as physical characteristics or tendency to engage in dangerous behavior. Inclusion of this crucial complication in the economic analysis of strict-liability waivers unearths an unraveling phenomenon that causes an entire market of buyers to all waive strict liability,

^{*} J.D., Harvard Law School, 2006.

even though they would in the aggregate be better off ex ante if they did not. The existence of such an unraveling phenomenon would devastate the economic argument for a waiver regime.

Unraveling begins as the failure of an insurance market. From a buyer's perspective, strict liability is essentially a form of insurance. Just like an insurance premium, the price buyers pay for strict liability (typically included in the price of the product) represents the sum of the average expected cost of injuries from product defects and the average cost of administering strict liability. If defective products injure a buyer, the seller compensates him for the loss. Like insurance, strict liability enhances aggregate buyer welfare by transferring wealth ex ante from non-injured buyers to injured buyers.

Also like a typical insurance system, buyers have varied utilities for strict liability and varied utilities for bearing the risk of defective products without strict liability. Buyers have varied predisposition to risk of harm from any given product based on innumerable factors such as age, health, or propensity to engage in dangerous behavior. And often buyers have at least a rough awareness of their individual risk to a given product defect. But just as often, sellers can not distinguish one buyer from another, and so the built-in "price" of strict liability reflects only the average expected loss from injury due to defective products, making strict liability an actuarially poor investment for many lower-risk buyers who have expected losses far less than the average buyer's expected cost. If given a choice, these lower-risk buyers would "waive" strict liability in return for additional amount they would pay for it (otherwise hidden in the price of the product).

Waiver by lower-risk buyers has three important consequences. First, the average expected injury loss from defective products rises since the lowest-risk buyers have left the strict-liability pool. Because the price of strict liability mostly reflects the average expected injury, the price of strict liability will rise. Second, the average cost of administering strict liability rises as well. Administrative costs are subject to economies of scale; as more buyers purchase strict liability, the average cost of administering it decreases. Conversely, as more buyers waive strict liability, the average cost of strict liability increases. This increase in average administrative costs also causes the price of strict liability to rise. Third, because his total risk exposure has decreased, the manufacturer will spend less on precautions, making the product less safe. Thus, waiver results in a coupling of higher strict-liability costs to decreasing returns in product safety. This coupling will induce another group of buyers to waive strict liability. Again, costs rise, benefits decrease, and the cycle repeats until all buyers have waived strict liability. In the end, the buyers have lower aggregate utility than if they had all purchased strict liability.

In a theoretical world without transaction costs, there is no danger that the strict-liability pool will unravel if it is the less-efficient outcome. In such a world, buyers can bargain and induce each other to purchase strict liability if to do so enhances utility. The buyers who initially derive the greatest utility from purchasing strict liability (presumably the higher-risk buyers) could transfer some of this surplus to the buyers who would otherwise maximize their utility by waiving (presumably the lowest-risk buyers), inducing them to not waive. By bargaining, buyers could preempt any unraveling.

Unfortunately, transaction costs do exist and prevent the buyers from bargaining. The costs necessary to coordinate bargaining between thousands or even millions of consumers would be astronomical. Even commercial buyers, often numerous themselves, would face insurmountable barriers to bargaining. Because of these prohibitive transaction costs, strict-liability pools may unravel, not because they reflect an efficient allocation of risk, but because buyers can't avoid it. The only remedy may be to prohibit buyers from waiving strict liability.

The goal of this paper is to expose this potential unraveling problem. Part I lays out the current state of products-liability law and provide a brief overview of the economic justifications for a strict-liability regime. Part II lays out the current legal status of strict liability waivers and present the paradigmatic economic arguments for a waiver regime. Part III explores the unraveling problem, specifically its application to waivers of strict liability for defective products. Part IV addresses possible limitations to the unraveling phenomenon. Part V concludes by recommending rules and methods to determine when a strict-liability pool is likely to unravel and might thus be bound together with a no-waiver regime.

I. Background

A. The Strict Liability Rule for Product Defects

According to the Restatement (Third) of Torts, commercial sellers and distributors of defective products are strictly liable for any resulting harm to persons or property.¹ This rule covers only manufacturing defects—those that depart from the

¹ RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 1 (1998); *see also id.* § 2(a) (stating that manufacturers are liable for manufacturing defects regardless of the degree of care they take in making the product). Both the Restatement and many jurisdictions hold all commercial sellers in the chain of sale strictly liable for product defects, notwithstanding whether they caused the defect. *Id.* § 1 cmt. e. The rationale is that

manufacturer's intended design—and does not subject a manufacturer to strict liability for defects in a product's design or for failures to warn consumers of potential harm.² Also, the rule covers only harm in the form of personal injury and property damage; it does not hold a manufacturer strictly liable for economic loss or damage to the product itself.³

A strong majority of jurisdictions have adopted some version of the Third Restatement's rule.⁴ Thirty-five states' courts have adopted the Second Restatement's rule, which is similar to the Third Restatement's rule, and three states have codified it.⁵ Five more states have adopted and codified language substantially akin to the Second Restatement's rule.⁶ Five states have created unique rules, opting instead for various court-created rules or statutes that vary from strict liability to different degrees.⁷

Alabama courts retain a requirement of fault that deviates only slightly from strict

through either liability or the market, these costs will eventually shift to the party that caused the defect. *Cf. id.* This distinction is largely irrelevant to the thesis of this paper, but it is worth noting for clarity.

² *Id.* § 1 cmt. a; *see also id.* § 2(b), (c) (stating that manufacturers incur liability for design defects or failures to warn only if the foreseeable risks could have reasonably been reduced by alternate designs or warnings, implying a negligence rule).

³ *Id.* § 1 cmt. d; *see also id.* § 21 (defining harm to persons or property to include economic loss only if it results from harm to the plaintiff's person, his property other than the defective product, or to another's person when it interferes with an interest of the plaintiff protected by tort law).

⁴ AMERICAN LAW OF PRODUCTS LIABILITY § 16:1 (3d ed. 2005).

⁵ *Id.* §16:9. The Restatement (Second) of Torts has a similar rule for products liability:

- (1) One who sells any product in a defective condition unreasonably dangerous to the user or consumer or to his property is subject to liability for physical harm thereby caused to the ultimate user or consumer, or to his property, if
 - (a) the seller is engaged in the business of selling such a product, and
 - (b) it is expected to and does reach the user or consumer without substantial change in the condition in which it is sold.

RESTATEMENT (SECOND) OF TORTS § 402A (1967).

⁶ AMERICAN LAW OF PRODUCTS LIABILITY, *supra* note 4, § 16:20.

⁷ *Id.* §§ 16:14 - :23; *see also* N.C. GEN. STAT § 99B-1.1 (2005) (“There shall be no strict liability in tort in product liability actions.”); *Handy v. Uniroyal, Inc.*, 327 F. Supp 596, 607 (D. Del. 1971) (holding that the Delaware version of the UCC, permitting disclaimers in contracts, preempts strict liability); *Swartz v. Gen. Motors Co.*, 378 N.E.2d 61, 62 (Mass. 1978) (holding that there is no strict liability in tort apart from breach of warranty); *Dooms v. Stewart Bolling & Co.*, 241 N.W.2d 738, 741 (Mich. Ct. App. 1976) (rejecting strict liability for products liability cases); *Logan v. Montgomery Ward & Co.*, 291 S.E.2d 685, 687 (Va. 1975) (holding that products liability rests either upon negligence or implied warranty);

liability.⁸ Finally, Georgia has codified a version of strict liability that substantively deviates only slightly from the Restatement's rule.⁹

B. Economic Rationales for Strict Liability

Over the long history of the product liability rule's development, a number of rationales have emerged to support it. These rationales nearly always have an economic justification behind them,¹⁰ though courts and commentators rarely make more than a superficial attempt to elaborate the mechanisms by which these rules further economic policy. Rationales for holding sellers strictly liability for product defects fall into one of two categories: those positing that manufacturers can prevent accidents better than a consumer can and those positing that manufacturers can bear risk better than consumers can.

1. Rationales Based on the Manufacturer's Comparative Advantage in Preventing Accidents

The first category of rationale posits that manufacturers are in a better position to prevent accidents than the ultimate consumers.¹¹ Manufacturers have a connection to and knowledge of the product that buyers do not.¹² Their greater familiarity with the product naturally allows for more accurate assessments of the possible risks a product poses and

⁸ AMERICAN LAW OF PRODUCTS LIABILITY, *supra* note 4, § 16:13.

⁹ *Id.* § 16:22.

¹⁰ *Cf.*, e.g., David Rosenberg, *Individual Justice and Collectivizing Risk-Based Claims in Mass Exposure Cases*, 71 N.Y.U. L. REV. 210 (1996); David Rosenberg, *The Causal Connection in Mass Exposure Cases: A 'Public Law' Vision of the Tort System*, 97 HARV. L. REV. 849 (1984). Obviously, some rationales are not economic in nature. But since this paper is concerned only with the economic consequences of the strict-liability rule, it addresses only economic reasoning.

¹¹ *See*, e.g., *Greenman v. Yuba Power Prod., Inc.*, 377 P.2d 897, 901 (Cal. 1963); RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 cmt. a (1998); AMERICAN LAW OF PRODUCTS LIABILITY, *supra* note 4 § 16:4. *But cf.* STEVEN SHAVELL, *ECONOMIC ANALYSIS OF ACCIDENT LAW* 58 – 60 (1987) (describing how applying strict liability to products only if they are defective incentivizes consumers to avoid accidents since they will bear the cost of harm if the product is not defective).

¹² *See* 63 AM. JUR. 2D *Products Liability* § 520 (1997); *cf.* William K. Jones, *Product Defects Causing Commercial Loss: The Ascendancy of Contract over Tort*, 44 U. MIAMI L. REV. 731, 764 (1990).

the best ways to mitigate them¹³. Conversely buyers may be completely unfamiliar with a product, and gathering the information needed to ascertain risks from defective products would be costly¹⁴. Manufacturers also have access, which buyers do not, to the tools, materials, and design processes that they can use to make a product safer.¹⁵ The connection manufacturers have to their product makes them better able to gather information about its risks and to mitigate them.

In addition to having an advantage over buyers in calculating a product's risks because of greater relative familiarity with the product, manufacturers can calculate the costs of taking precautions better than buyers because of their size. To bear the risk of product defects, manufacturers must minimize total accident costs, calculated as the sum of the total injury the defective product causes, the cost of precautions taken, and costs of administering strict liability.¹⁶ These calculations can be quite complex and overwhelming,¹⁷ but manufacturers have ready access to designers and other professionals useful for determining risk and precautions, which buyers do not.¹⁸ Furthermore, manufacturers can also exploit economies of scale to investigate risk and implement precautions more cheaply than thousands or millions of buyers acting independently.¹⁹

¹³ See 63 AM. JUR 2D *Products Liability*, *supra* note 12.

¹⁴ See *id.*

¹⁵ See *id.*

¹⁶ In a strict liability regime, the seller or manufacturer must either pay for or pass on to consumers both the cost of precautions *P* and the cost of accidents *C*. See SHAVELL, *supra* note 11, at 64 – 65. If the seller or manufacturer must pay for these costs itself (perhaps it is a monopolist and will simply deduct them from its supra-competitive prices) it obviously wishes to minimize them to save itself money. *Id.* If it must pass these costs on to consumers, it obviously wishes to minimize them to remain competitive in the market. *Id.*

¹⁷ See *e.g.*, *id.*

¹⁸ See 63 AM. JUR. 2D *Products Liability*, *supra* note 12 § 520.

¹⁹ See Jones, *supra* note 12, at 764.

Finally, there are many products that practically can be made more or less safe by the manufacturer, but cannot be rendered significantly more or less safe by the ultimate user. For example, in *Green v. Smith & Nephew AHP, Inc.*,²⁰ the Wisconsin Supreme Court upheld a trial verdict for a plaintiff who suffered an allergic reaction after donning a pair of defective latex gloves. Other than abstaining from wearing the gloves, there was nothing the plaintiff could have done to make them safer, if for no other reason than because she may not have known of or understood the risk the latex posed.²¹ Similarly, there are many products that can be made safer by both the manufacturer and the consumer, but much more cheaply by the manufacturer.²² In *Matthews v. Wal-Mart Stores, Inc.*,²³ the plaintiff sued Wal-Mart after a defective lamp she bought there caused a fire in her home. Matthews might have perhaps prevented this fire by installing fire sprinklers, but it seems simply cheaper for the lamp's manufacturer to make a safer lamp. Many products are complete and difficult to alter or make safer once they leave the manufacturer.²⁴

2. Rationales Based on the Manufacturer's Comparative Advantage in Bearing Risk

²⁰ 629 N.W.2d 727 (Wis. 2001).

²¹ *See id.* at 804. Generally, it is difficult to imagine reasonable precautions the plaintiff in *Green* could have taken that would have made the gloves safer.

²² *See* AMERICAN LAW OF PRODUCTS LIABILITY, *supra* note 4 § 16:4.

²³ 708 So. 2d 1248 (La. Ct. App. 1998).

²⁴ *See Escola v. Coca Cola Bottling Co. of Fresno*, 150 P.2d 436 (Cal. 1944) (holding that a soda bottle was defective, in that it was prone to explode, when it left the bottling plant and that reasonable precautions would not have made it safer). Obviously, manufacturers will not always be able to prevent defective products from harming consumers more cheaply and easily than consumers themselves can. For example, in *Beattie v. Beattie*, 786 A.2d 549 (Del. Super. Ct. 2001), a car accident victim alleged the manufacturer of his car was strictly liable for his injuries he sustained after crashing into a truck driving in front of him because the safety restraint system had failed. Rather than require Oldsmobile spend vast amounts of money redesigning its safety system, it might be cheaper and easier to encourage Beattie to drive more carefully. The strict liability rule, however, applies only to product defects, which appear to pose harms not easily avoided by consumers, thus generally fitting the unilateral accident paradigm. *See, e.g., Escola*, 150 P.2d 436; *Matthews*, 708 So. 2d 1248.

The second category of reasons that support a strict-liability rule for defective products posit that manufacturers are generally in better positions than consumers to bear the loss from accidents.²⁵ Manufacturers tend to be large firms, which are generally better able to bear a loss than individual buyers.²⁶ Large firms tend to be less risk averse than buyers since their shareholders have diverse portfolios and are unconcerned with the risk of any individual firm.²⁷ As less risk averse than buyers, manufacturers can turn strict liability into a form of insurance; buyers pay for the average accident cost as part of a product's price, and sellers bear the actual risk of accident.²⁸ Thus, a manufacturer's size allows it to bear risk better than a consumer can.

Finally, manufacturers may be able to bear risk of injury from defective products better than buyers since they can more easily and cheaply purchase liability insurance for such risks. The somewhat-tenuous argument is that manufacturers may be able to purchase insurance more cheaply than can all individual consumers by taking advantage of an information economy of scale.²⁹ An insurer must incur the cost of ascertaining information about a risk before it can decide whether and how to insure against it. To insure buyers against the risk of a defective product, insurers of innumerable individual

²⁵ See, e.g., *Azzarello v. Black Bros. Co.*, 391 A.2d 1020, 1023 (Pa. 1978) (holding that suppliers of a defective product should bear the risk because they are in a good position to absorb the loss and pass it on to buyers); RESTATEMENT (THIRD) OF TORTS: PROD. LIAB § 2 cmt. a (2005); AMERICAN LAW OF PRODUCTS LIABILITY, *supra* note 4 § 16:4.

²⁶ See, e.g., SHAVELL, *supra* note 11, at 189–90.

²⁷ *Id.*

²⁸ See 63 AM. JUR. 2D *Products Liability*, *supra* note 12 § 520.

²⁹ See, e.g., *Embs v. Pepsi-Cola Bottling Co. of Lexington, Kentucky*, 528 S.W.2d 703, 705 (Ky. Ct. App. 1975) (stating that “public policy demands that the burden of accidental injuries . . . be treated as a cost of production against which liability insurance can be obtained”); AMERICAN LAW OF PRODUCTS LIABILITY, *supra* note 4 § 16:4; Note, *Title VII of the Civil Rights Act of 1964*, 92 HARV. L. REV. 299, 309 (1978). Professor Shavell has raised two possible counterarguments to this point: first, that individuals need not purchase seemingly expensive insurance for this specific risk since they purchase much cheaper general insurance against a wide range of risks, and second, that liability insurance poses additional administrative costs (such as those associated with litigating claims) that first-party insurance does not. SHAVELL, note 11, at 214.

consumers would have to learn about this risk and the potential insured buyer's risk to it.³⁰ Alternatively, an insurer can learn about the aggregate risk one seller poses to all of these buyers.³¹ It is obvious that one insurer working with one insured seller, even to insure many transactions, can gather information more cheaply in the aggregate than can many different insurers working with innumerable insured buyers.³² Additionally, insurers can monitor sellers to ensure adequate precautions more cheaply than they can monitor buyers; it is cheaper for an insurer to visit and inspect one or a few manufacturing plants to ensure sellers are taking proper precautions than to visit and inspect thousands or millions of buyers to ensure they are using a product safely.³³

C. A Preliminary Economic Model of Strict Liability for Product Defects

Professor Shavell has modeled strict liability much more comprehensively than have many of the courts and commentators to which I have referred thus far.³⁴ This paper relies upon these models of strict liability to demonstrate the unraveling phenomenon. I introduce the basic model here.

As with all economic models, this model makes several simplifying assumptions. In this model, buyers can do nothing to make the product safer; the accident model is unilateral. The manufacturer cannot distinguish between buyers; he only knows information about the average buyer. Finally, this model assumes the market for both the product itself and the accompanying strict liability is perfectly competitive. Thus the total price of a product will shrink to the sum of the cost of making it and the cost of providing strict liability. In later sections, we will explore the consequences when these

³⁰ *But see* SHAVELL, note 11

³¹ *But see id.*

³² *But see id.*

³³ *But see id.*

³⁴ *See* SHAVELL, note 11, at 66 – 72.

assumptions do not hold, but for the sake of simplicity I have included them in the basic model.

The model begins with the Total Cost (TC) of producing a product unit if manufacturers are subject to strict liability. It is this cost the manufacturer must bear and pass back to buyers. Four elements comprise the Total Cost: the cost of making the product itself (C), the cost of making the product safer (X), the costs of administering strict liability (A), and the total accident cost. The total accident cost is actually the sum of all individual accident costs, each of which is in turn the product of two sub-elements: the risk of injury from product defect (R), and the loss such an injury would cause (L).

Some of these variables are functions of other variables. In this model, the cost of administering strict liability (A) is a function of the number of buyers (B). This cost of strict liability (A) may be any function of the number of buyers (B) as long as it satisfies the following inequalities:

$$\text{(eq. 1) } A(B) \geq 0^{35} \quad \text{(eq. 2) } A'(B) \geq 0^{36} \quad \text{(eq. 3) } A''(B) \leq 0^{37}$$

Also, the risk of injury from product defect (R) is a function of the amount spent making the product safer (X) and each buyer's individual characteristics, which the model will incorporate by assigning each buyer a number (n). Like the cost of administering strict liability (A), the risk of injury (R) may be any function as long as it satisfies three inequalities:

$$\text{(eq. 4) } 0 \leq R(X, n) \leq 1^{38} \quad \text{(eq. 5) } \frac{\partial R(X, n)}{\partial X} \leq 0^{39} \quad \text{(eq. 6) } \frac{\partial^2 R(X, n)}{\partial X^2} \geq 0^{40}$$

³⁵ Equation 1 reflects that the administrative costs are always positive.

³⁶ Equation 2 reflects that as the number of buyers (B) increases, so does the cost of administering strict liability.

³⁷ Equation 2 and 3 together reflect that as the number of buyers (B) increases, the cost of administering strict liability increases, but increases less and less. To state this another way, the cost of administering strict liability increases in the aggregate, but decreases per buyer.

The model could be even more complex. For example, the loss a buyer experiences from a defective product (L) could also be a function of the amount the manufacturer spends on precautions. For simplicity's sake, however, A and R will be the only complex variables in this model.

The model runs as follows. In a perfectly competitive market, the manufacturer must sell a product with strict liability at a price that reflects only the cost of making the product, making it safer, and providing strict liability. This Total Cost, to which I referred above, is thus:

$$(eq. 7) \quad TC = C + X + A(B) + \sum_{n=1}^B R(X, n)L$$

From Equation 7, we can see that Total Cost varies with the amount the manufacturer spends on precautions. The manufacturer will adjust this expenditure to minimize the Total Cost and stay competitive in a perfect market. The Total Cost is lowest when the following condition is met:

$$(eq. 8) \quad \frac{\partial(TC)}{\partial X} = 1 + L \sum_{n=1}^B \frac{\partial R}{\partial X} = 0$$

The manufacturer will thus spend the amount on precautions that satisfies Equation 8.

This is the basic model of strict liability from which we will explore the unraveling phenomenon. I will adjust some of the parameters to demonstrate the existence of unraveling in a variety of markets, but the adjusted models stem from this

³⁸ Equation 4 reflects that R is a probability and thus ranges from 0% ($R = 0$) to 100% ($R = 1$).

³⁹ Equation 5 reflects that as the manufacturer spends more money on precautions, the risk of injury from defective products decreases.

⁴⁰ Together, Equations 5 and 6 reflect that although the risk of injury from a defective product decreases with the amount of money the manufacturer spends on precautions, it decreases less and less.

basic model. In the next section, I will illustrate how allowing buyers to waive strict liability changes the model.

II. Waivers of Strict Liability

A. Description of a Waiver Regime

In a waiver regime, buyers can opt out of strict liability. Sellers can induce buyers to waive in return for some quid pro quo, presumably a monetary return.⁴¹ In accordance with the Third Restatement, most jurisdictions that have strict liability for defective products do not allow buyers to waive in any circumstances;⁴² that is, they have no-waiver regimes. The Third Restatement does, however, acknowledge the argument for allowing waiver in commercial transactions, and some jurisdictions permit this.⁴³

B. Economics of a Waiver Regime

To better understand the benefits of a waiver regime, I begin with a mechanical description of strict liability. Under a strict-liability regime, the Total Cost of a product comprises the cost of the product itself, the cost of making the product safer, the additional costs of administering strict liability claims, and the resulting accident losses from defective products.⁴⁴ To turn any profit, the manufacturer must pass these costs on to buyers. Thus, for each unit of a product a buyer purchases, he pays for the cost of

⁴¹ Cf. 63 AM. JUR. 2D *Products Liability*, *supra* note 12 § 1401 (stating that releases from liability usually take the form of a contract).

⁴² AMERICAN LAW OF PROD. LIAB., *supra* note 4 § 16:31; *see* RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 18 (1998). *Compare* *Sterner Aero AB v. Page Airmotive, Inc.*, 499 F.2d 709, 713 (10th Cir. 1974) (holding that in Oklahoma, disclaimers do not bar an action in products liability), *with* *Keystone Aeronautics Corp. v. R. J. Enstrom Corp.*, 499 F.2d 146, 149 (3d Cir. 1974) (holding Pennsylvania permits a waiver of strict liability if negotiated by two business parties of relatively equal strength).

⁴³ AMERICAN LAW OF PROD. LIAB., *supra* note 4 § 16:32; *see* RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 18 cmt. d (acknowledging the argument for allowing waiver when made in a commercial transaction between two parties of roughly equal bargaining power if the waiver provides for adequate contract remedies); *see, e.g.*, *Idaho Power Co. v. Westinghouse Elec. Corp.*, 596 F.2d 924, 928 (9th Cir. 1979) (holding Idaho's Uniform Commercial Code allowed commercial parties of relatively equal bargaining strength to waive strict liability).

⁴⁴ *See supra* p. 13.

making the product, the average cost of precautions, the average accident cost, and the average cost of administering strict liability. In return for paying the additional costs—the costs of strict liability—buyers get a kind of insurance against accident loss from defective products. Should a defective product injure a buyer, the seller must pay for the resulting personal injury.

One modification to this strict-liability regime, hereinafter referred to as a waiver regime, would be to allow buyers to waive their “right” to hold the manufacturer strictly liable for injury from defective products. In return, the manufacturer would provide them with some quid pro quo, most likely a discounted price that reflects the saved costs of accident loss and administration of strict liability, which the seller now does not bear for this buyer.⁴⁵ Note also that because for such products the seller no longer bears any risk of accident costs, it will spend less money on precautions.⁴⁶

The accident costs do not simply disappear; rather they shift to the buyer. Why might a buyer want to forgo the insurance that strict liability provides and bear these costs themselves? There are several economic reasons why a buyer might prefer to waive. First, a buyer might be able to make the product just as safe as the seller could, but at a cheaper cost (and perhaps in a different way). Second, a buyer might have a lower than average risk of injury from a particular defective product; if it is significantly lower than average, the buyer would rather bear his own risk of accident cost than pay for

⁴⁵ Rather than think about the “discount” for waiver, we might instead conceptualize a no-liability default regime and think about the “cost” of strict liability. These are just two ways to think about the same concept, but later in the paper I will refer more often to the “cost” of strict liability.

⁴⁶ Of course, manufacturers might have other reasons to spend money making their product safer. For example, the federal government regulates many aspects of product safety. Nevertheless, apart from liability, manufacturers seem to lack incentives to take optimal safety. Cf. Glenn Kaplan & Chris Barry Smith, *Patching the Holes in the Consumer Product Safety Net: Using State Unfair Practices Laws to Make Handguns and Other Consumer Goods Safer*, 17 YALE J. ON REG. 253, 255 (2000) (asserting that the two biggest incentives for firms to make goods safer are the threat, though not the existence, of regulation and tort liability).

the much greater average accident cost of all other buyers. Third, and perhaps most importantly, many scholars have simply suggested that the tort system provides an inefficient form of insurance.⁴⁷ Under this view, deterrence should be the goal of a tort system.⁴⁸ Because an individual buyer's pro rata share of investment in precautions, included in the price of the product, makes his purchased product only infinitesimally safer, he might rather freeride and enjoy only those protections that other purchaser finance.⁴⁹

C. Criticisms of a Waiver Regime

Waiver regimes have been the subject of much criticism. The Achilles Heel of a waiver regime is its dependence on a well-working market for the allocation of risk between sellers and buyers.⁵⁰ It is here that critics of a waiver regime focus their fire. They point to market failures that work to prevent such a well-working market. In particular, critics point to disparities in bargaining power and information that would frustrate a well-working market for risk. Although these criticisms are formidable thrusts upon the waiver regime, waiver proponents have parried convincingly, demonstrating that the existence of such ostensible market failures may not actually prevent buyers and sellers from allocating risk efficiently.

1. Disparities in Bargaining Power

⁴⁷ STEVEN SHAVELL, FOUNDATIONS OF ECONOMIC ANALYSIS OF LAW 268 – 69 (2004). Professor Shavell notes that the compensation function of tort liability arose before the development of insurance markets, and thus liability then provided tort victims with compensation for a loss they otherwise could not have received. *Id.*; see also David Rosenberg & Steven Shavell, *A Simple Proposal to Halve Litigation Costs*, 91 VA. L. REV. 1721, 1730 (2005); David Rosenberg, *Class Actions for Mass Torts: Doing Individual Justice by Collective Means*, 62 IND. L. J. 561, 575 (1987).

⁴⁸ *Id.*

⁴⁹ This presents a classic freerider problem in which an individual's contribution to a common good – the investment in precaution – increases the value of that good – the safety of the product – by an amount greater than the investment, but the pro rata share of that increased value to the individual is less than the investment. See, e.g., SHAVELL, *supra*, note 47, at 10 – 16. Thus, a buyer might not wish to finance a precaution that results in only a small gain in safety to him, though a large gain in aggregate safety.

⁵⁰ See *supra* p. 2.

Many critics assert that waiver regimes will fail to allocate risk efficiently because individual buyers have negligible bargaining power relative to large sellers.⁵¹ They argue that the paradigm of retail, in which sales personnel have no authority to bargain and the actual sellers are far removed from the masses of retail buyers, leads only to take-it-or-leave-it contracts of adhesion.⁵² If buyers do not have bargaining power, sellers are free to offer prices that do not properly compensate buyers if they waive strict liability; sellers will offer strict-liability waivers in exchange for discounts that do not reflect the full savings in terms of the cost of accident loss and administration of strict liability, which the seller no longer bears.⁵³ If buyers do not have bargaining power, sellers can take advantage of buyers and capture the surplus of welfare that waivers create.

Proponents of a waiver regime answer this charge by directly disputing the claim that buyers do not have power within the market. In a competitive market, sellers must compete to win buyers, driving the price of the good down to its cost.⁵⁴ Increasing competition from foreign markets and burgeoning domestic markets lead to even “greater competition and consumer choice.”⁵⁵ Generally, individual buyer bargaining power is unnecessary to bring about this state of market efficiency since competition induces sellers to set the lowest possible price for their product; buyers will shop around for the

⁵¹ See, e.g., Richard C. Ausness, “Waive” Goodbye to Tort Liability: A Proposal to Remove Paternalism from Product Sales Transactions, 37 SAN DIEGO L. REV. 293, 312 – 13 (2000); Michael B. Metzger, Disclaimers, Limitations of Remedy, and Third Parties, 48 U. CIN. L. REV. 663, 687 (1979) (“The average consumer generally lacks substantial bargaining power.”); Note, Disclaimers of Warranty in Consumer Sales, 77 HARV. L. REV. 318, 328 (1963) (“The comparative helplessness of the modern consumer generally eliminates the possibility of a free and informed choice to assume a risk . . .”).

⁵² See, e.g., Ausness, *supra* note 51, at 313; Friedrich Kessler, *Contracts of Adhesion – Some Thoughts About Freedom of Contract*, 43 COLUM. L. REV. 629, 632 (1943); William L. Prosser, *The Assault upon the Citadel (Strict Liability to the Consumer)*, 69 YALE L.J. 1099 (1960).

⁵³ See *supra* p. 16 – 17.

⁵⁴ See, e.g., Ausness, *supra* note 51, at 314; Duncan Kennedy, *Distributive and Paternalist Motives in Contract and Tort Law, with Special References to Compulsory Terms and Unequal Bargaining Power*, 41 MD. L. REV. 563, 608 (1982).

⁵⁵ Ausness, *supra* note 51, at 313.

best prices, and sellers will be forced to undercut each other to win buyers.⁵⁶ In the waiver context, sellers will have to increase the discount they offer for in exchange for waiver until it equals the average amount in accident losses and administrative costs the seller will save if not subject to strict liability.⁵⁷ This applies nothing but the simple and well-accepted basic argument for market efficiency.

Additionally, Professor Ausness observes that the initial buyer of manufactured products is often a large firm, such as Wal-Mart, and these intermediaries certainly have the bargaining power to negotiate with manufacturers for waivers that properly reflect the manufacturer's saved cost in providing them.⁵⁸ Wal-Mart can then sell a waiver to consumers for a slightly greater amount (increased to recoup the costs that Wal-Mart incurs in providing the waiver).⁵⁹ Although the ultimate consumers have little individual bargaining power, large retailers have the bargaining power necessary to negotiate waiver agreements that capture the full manufacturer's savings of forgone strict liability. Then if the market is competitive at the retail level, large retailers must pass on this full savings to consumers who waive strict liability.

2. Disparities in Information

Many critics also assert that waiver regimes will fail to allocate risk efficiently because either the buyer, or seller, or both lack the information necessary to exploit the possible economic advantages of waiver.⁶⁰ As we have seen thus far, understanding the

⁵⁶ See *supra* note 54.

⁵⁷ Cf. *supra* note 54. Recall that these are the additional "costs" of strict liability. See *supra* note 45.

⁵⁸ Ausness, *supra* note 51, at 313 – 14.

⁵⁹ Cf. *id.* Recall that without a waiver from consumers, Wal-Mart will be strictly liable to them for defective products. See *supra*, note 1.

⁶⁰ See, e.g., Jones, *supra* note 12, at 773 – 78; Peter M. Kinkaid & William J. Stuntz, *Enforcing Waivers in Products Liability*, 69 VA. L. REV. 1111, 1122 (1983). See generally SHAVELL, *supra* note 11, at 53 – 54 (describing the consequences of buyer ignorance of risks where a firm has caused harm to a customer).

benefits of waiver requires a complicated and economically expert calculus of risks,⁶¹ which might be beyond the grasp of some parties to a waiver transaction.⁶² Critics fear that if the parties cannot understand this calculus, they will buy or sell waivers at prices that deviate from the cost the seller actually forgoes, jeopardizing the efficiencies that waivers promise.⁶³

Like criticisms based on bargaining power, however, proponents of waiver regimes have assuaged information-based criticisms as well. For example, one fear is that ignorant buyers unaware of the risks a product poses will waive liability too cheaply.⁶⁴ Professor Jones disposes of this concern, at least for commercial retailers.⁶⁵ In this disposition, he assumes competitive wholesale and retail markets, but that some retailers are ignorant of the risks posed by defective products.⁶⁶ Jones argues that where both the wholesale and retail markets are competitive, informed retailers who receive the optimal discount (that which reflects the forgone cost of providing it) for a waiver will have an advantage in the downstream retail market since they will be able to offer their waivers to downstream buyers at a similar optimal discount.⁶⁷ Ignorant buyers, duped into accepting a less than full discount for waiving strict liability, will be under great pressure to provide waivers for less than they paid to match the price for waivers that their informed competitors offer at the retail level.⁶⁸ They will either negotiate larger

⁶¹ See *supra* pp. 11 – 13.

⁶² See *supra* note 60.

⁶³ See Jones, *supra* note 12, at 773; Kinkaid & Stuntz, *supra* note 60, at 1123 – 24.

⁶⁴ See Jones, *supra* note 12, at 773; Kinkaid & Stuntz, *supra* note 60, at 1123. Note that Jones describes a situation in which the baseline is no liability, and buyers, unaware of the benefits, decide not to purchase liability. See Jones, *supra* note 12, at 773. The point is the same; buyers will make inefficient choices if they are unaware of risk.

⁶⁵ See Jones, *supra* note 12, at 773 - 79.

⁶⁶ *Id.*

⁶⁷ *Id.*

⁶⁸ *Id.*

discounts for waiver in the wholesaler market or leave the market altogether.⁶⁹ As long as some retailers are informed about the risk calculus regarding waivers, all retailers in the market must make waivers available at optimal prices.

A similar fear expressed by critics of the waiver regime is that even if buyers are informed of the benefits of strict liability and waivers, sellers may not be.⁷⁰ In this situation, Professor Jones assumes that sellers will tend not to offer strict liability at all since they wish only to provide the lowest price possible.⁷¹ In a competitive market, however, sellers that do realize the benefits of waiver will provide them to their buyers and either share in the surplus or win buyers from sellers who do not realize these benefits.⁷²

There are some situations in which waiver causes problems that are simply unavoidable. For example, Professor Jones concedes that if all buyers and all sellers are ignorant, there is no way the parties will arrive at an efficient waiver decision.⁷³ However, these situations are likely to be few and far between, at least on a large scale, and are generally not the kinds of problems solvable by tort law.

D. Summary of Current Waiver Analysis

Scholars have launched a comprehensive assault on the traditional economic arguments against a waiver regime. In the next section, I present a new argument, not yet considered by either courts or scholars. It demonstrates that even in the event of a well-working market for risk that includes informed buyers and sellers of equal bargaining

⁶⁹ *Id.*

⁷⁰ *Id.* at 777.

⁷¹ *Id.* Of course, it is quite possible that sellers overestimate the benefits of strict liability. Again, the problem above arises in which, depending upon the particular misperception, inefficiency is likely.

⁷² *Id.*

⁷³ *Id.* at 777 – 78.

power, a waiver regime can still be inefficient. This dangerous possibility is not a mere deviation from optimal precautions or waiver price, but a catastrophic cascade by which all parties end up significantly worse off than they would have been in a no-waiver regime.

III. The Unraveling Phenomenon

A. The General Problem

The nature of economics is to simplify.⁷⁴ By simplifying reality, retaining the important variables, economists can create descriptive and predictive models.⁷⁵ However, these models fail to describe or predict reality if important variables are assumed away and ignored.⁷⁶

Thus far, all models of strict liability we have observed assumed that buyers have homogeneous predisposition to risk.⁷⁷ This is obviously a simplification for at least some products. For example, recall the plaintiff in *Green v. Smith & Nephew AHP, Inc.*,⁷⁸ who suffered an allergic reaction from latex gloves. The range of allergic reactions from latex products runs the gamut from fairly innocuous dermatitis to gross histamine release, sometimes even resulting in death.⁷⁹ In this section, we uncover the consequences of including in our models the heterogeneity of buyers' predisposition to risk from defective products.

⁷⁴ Cf. SHAVELL, *supra* note 47, at 3 (noting that while all sorts of personal utilities – such as aesthetic preference, altruistic feelings, or a desire for fairness – can be the subjects of economic analysis, standard economic analysis simplifies by “restricting attention to fairly simple measures of social welfare”).

⁷⁵ Cf. *id.* at 2 – 4.

⁷⁶ See ROBERT S. PINDYCK & DANIEL L. RUBINFELD, MICROECONOMICS 5 – 6 (5th ed. 2001).

⁷⁷ See *supra* notes 44 - 49 and accompanying text.

⁷⁸ 627 N.W.2d 727 (Wis. 2001).

⁷⁹ Better Health Channel, Latex Allergy, http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Latex_allergy (Sep. 20, 2002) (describing the wide range of latex allergy symptoms and severity for different individuals); see also Kenneth K. Meyer & Donald H. Beezhold, Latex Allergy: How Safe Are Your Gloves?, <http://www.facs.org/about/committees/cpc/oper0797.html> (last visited Jan. 14, 2005) (“Allergic reactions to natural rubber latex products range from mild contact dermatitis to eczema, rhinoconjunctivitis, asthma, anaphylaxis, and unexplained intraoperative death.”).

There is a disconnect between the discount a seller can offer a buyer to waive strict liability and the discount a buyer might fairly receive to waive strict liability. Agreements to waive strict liability reflect average costs.⁸⁰ Sellers typically have neither the resources nor the opportunity to distinguish one buyer from another in terms of predisposition to risk.⁸¹ In a strict liability regime, the discount a seller will offer a buyer to waive strict liability will reflect only the average costs of administering strict liability and the average costs of accident loss.⁸² But buyers have individual predispositions to risk of accidents.⁸³ Thus, the discount a seller offers to waive strict liability will for many buyers not represent the actual cost a seller will forgo if that particular buyer waives.

The disconnect between buyers' actual risks and the average discount a seller can offer to waive strict liability causes a problem. Unlike sellers, buyers often know or can at least roughly estimate their individual predisposition to risk.⁸⁴ If the buyers' variation in risk is great enough, lower-risk buyers (those who for whatever reason have lower risk of accident than other buyers) will find that this average cost of strict liability⁸⁵ is too expensive. To state this important point another way, it would not be sensible for a buyer with little or no risk of injury from a product to subsidize losses and costs of strict

⁸⁰ Cf. Gwyn D. Quillen, *Contract Damages and Cross-Subsidization*, 61 S. CAL. L. REV. 1125, 1129 (1988) (asserting that if sellers are held liable for expectation damages if they breach a sales contract, they will set the price of their product as the sum of the marginal cost of producing it and the average cost of damages).

⁸¹ Cf. *id.*

⁸² Cf. *id.*

⁸³ See *supra* notes 77 – 79 and accompanying text.

⁸⁴ Cf. Quillen, *supra* note 80, at 1130 (describing how heterogeneous buyers are aware of their individual expectation damages in the event of a sales contract breach).

⁸⁵ Recall that the “cost” of strict liability is another way of thinking about the “discount” of waiver. See *supra* note 45.

liability for higher-risk buyers.⁸⁶ If given a choice, the lower-risk buyers will waive strict liability.

It is this waiver by lower-risk buyers that drives the unraveling phenomenon. Waiver by the lower-risk buyers causes three important results. First, the average risk for which the seller is strictly liable increases since the lowest-risk buyers are no longer part of the strict-liability pool of buyers. The cost of strict liability for each member remaining in the pool rises to meet this new average accident cost. Second, the average cost of administering strict liability will likely rise. This is because economies of scale allow average administration costs to fall as more buyers participate in the strict liability pool.⁸⁷ Third, the seller will take fewer precautions or spend less money making the product safer since its total liability for accidents has decreased.⁸⁸ In sum, when lower-risk buyers waive strict liability, the buyers who have not waived will pay more for strict liability but will receive less. This in turn will induce more buyers to opt out: those on the margin who originally found strictly liability just slightly more efficient than waiver but who now find waiver more efficient. Again costs rise, and benefits fall. This cycle repeats until the entire strict liability pool has unraveled and all buyers have waived. As we will see, in the end buyers may be worse off in the aggregate ex ante than if none had waived.

⁸⁶ See *supra* pp. 14 – 16 (explaining why in most markets the discount for waiver will rise to the average cost of providing strict liability).

⁸⁷ For example, the cost of litigating the first case in an incidence of defective products is likely to be much more costly than litigating subsequent cases; lawyers need not refamiliarize themselves with the case, rediscover evidence, etc. Cf. Amy Wolaver et al., *Mandating Insurance Offers for Low Wage Workers: An Evaluation of Labor Market Effects*, 28 J. HEALTH POL. POL'Y & L. 883, 885 (2003) (describing the benefits of scale economies in lowering administrative costs of health insurance); Karen M. Gebbia-Pinetti, *Select Advisory Committee on Business Reorganization (SABRE): Annotated List of Resources*, 57 BUS. LAW. 245, 252 (2001) (stating that administrative costs of bankruptcy decrease as the size of the bankrupt firm grows).

⁸⁸ Generally, optimal precautions grows with the total accident cost. See *supra* pp. 11 – 13.

Theoretically, if buyers are better off in the aggregate ex ante if they all do not waive, they could transfer that surplus to those buyers that otherwise would waive and preempt any unraveling. In reality, however, transaction costs make the coordination needed to induce thousands or even millions of consumers to bargain impossible.⁸⁹ To remedy this problem of transaction costs, mandatory strict liability may perform a kind of gap-filling function – an insertion of efficient terms upon which buyers would agree if they could bargain without cost.⁹⁰

B. Unraveling Models

1. The Simplest Model: Risk-Neutral Buyers and No Variation in the Cost of Precautions

I begin with a basic, simple model of unraveling. Imagine a manufacturer sells a product to three buyers. Buyer 1 has a 5% chance of suffering a \$100 accident loss, Buyer 2 has an 10% chance of suffering the \$100 loss, and Buyer 3 has a 12% chance. The cost to the seller of administering strict liability is \$1. Total expected loss from all three buyers is then \$28;⁹¹ this is the Cost of Strict Liability,⁹² which the manufacturer must pass on equally to each buyer. The buyers know their own risks, but the seller cannot distinguish between the three and only knows aggregate and average risk. For the moment, ignore variation in precautions, and assume buyers are risk neutral.

⁸⁹ Cf. Note, *Efficiency and a Rule of 'Free Contract': A Critique of Two Models of Law and Economics*, 97 HARV. L. REV. 978 – 80 (1984) (explaining that liberal legal theorists argue that transaction costs prevent consumers from effectively bargaining with manufacturers for warranties). If transaction costs prevent myriad consumers from bargaining with a few manufacturers, then, a fortiori, transaction costs should prevent myriad consumers from bargaining with each other.

⁹⁰ This approach is similar to a gap-filling theory of contract by which courts fill gaps in contracts with terms they believe the parties would have bargained for if they had addressed the gap. See Jules L. Coleman, Douglas D. Heckathorn, & Steven M. Maser, *A Bargaining Theory Approach to Default Provisions and Disclosure Rules in Contract Law*, 12 HARV. J.L. & PUB. POL'Y 639 (1989).

⁹¹ $(5\%)(\$100) + (10\%)(\$100) + (12\%)(\$100) + \$1 = \$5 + \$10 + \$12 + \$1 = \$28$.

⁹² See *supra* pp. 11 – 13.

If allowed to waive strict liability, this pool of buyers will unravel. Initially if the manufacturer assumes all three buyers will purchase strict liability, he will charge each buyer \$9.33.⁹³ It is easy to see that Buyer 1 will waive; he would rather have an expected \$5 accident loss than a loss of \$9.33 to pay for strict liability. Buyer 2 will not waive since a \$9.33 cost of strict liability is less than a \$10 expected accident loss. After Buyer 1 waives, the total Cost of Strict Liability is now \$23,⁹⁴ which the seller passes on equally to Buyers 2 and 3: \$11.50 each. Now Buyer 2 will waive since he would rather bear his expected accident loss of \$10 than pay \$11.50 for strict liability. Buyer 3 will still not waive since the strict liability cost of \$11.50 is less than his expected accident loss of \$12. Now Buyer 3 is the only remaining buyer in the pool. The manufacturer will have to pass back the entire \$13 cost only to Buyer 3, making it efficient for Buyer 3 to waive since a \$13 cost of strict liability is greater than his \$12 expected accident loss. We can see that after each “round” of buying, another buyer waives strict liability until all buyers have waived and the pool unravels.

This simple model makes the unraveling phenomenon clear and easy to understand. But it does not explain why unraveling is normatively undesirable in terms of economic goals. To demonstrate the undesirability of unraveling, we must include the utility of wealth to each buyer.

2. Unraveling and Risk-Averse Buyers

Unraveling may be normatively undesirable because in the aggregate, buyers’ utility may be greater if the pool does not unravel. Again imagine three buyers. They

⁹³ $\$28 \div 3 = \9.33 .

⁹⁴ $(10\%)(\$100) + (12\%)(\$100) + \$1 = \$10 + \$12 + \$1 = \$23$.

each have a starting wealth of \$100, and have a utility (U) for their wealth (W). U varies with the square root of W :

$$\text{(eq. 9) } U = \sqrt{W}^{95}$$

Buyers 1, 2, and 3 each buy a product that poses a 5%, 10%, and 15% chance, respectively, of harming them through some defect and causing each to lose all \$100 dollars. Administering a strict liability system costs a manufacturer a flat \$15. We will see how such a model unravels and how aggregate utility decreases.

If the manufacturer initially assumes that all buyers will purchase strict liability, he will charge \$15 to each of them.⁹⁶ If all buyers purchase strict liability, their total utility will be:

$$\text{(eq. 10) } U_{\text{nowaive}} = 3\sqrt{100-15} = 27.65 \text{ or } 9.22 \text{ each}$$

Compare this utility to the utility Buyers 1 and 2 would have if they waived, bearing only their expected accident costs:

$$\text{(eq. 11) } U_{1\text{waive}} = (1 - .05)\sqrt{100} = 9.5^{97} \quad \text{(eq. 12) } U_{2\text{waive}} = (1 - .10)\sqrt{100} = 9.0^{98}$$

From Equations 10, 11, and 12, we can see that if allowed to waive, Buyer 1 will do so but Buyers 2 and 3 will not.

⁹⁵ This function is merely one way to represent that buyers value their wealth at a diminishing marginal rate; they are risk averse. See SHAVELL, *supra* note 11, at 186 - 189. Note the U that Equation 9 defines satisfies both conditions for a function representing diminishing marginal utility of wealth:

$$U'(W) = \frac{1}{2}(W)^{-\frac{1}{2}} > 0 \quad \text{and} \quad U''(W) = -\frac{1}{4}(W)^{-\frac{3}{2}} < 0.$$

⁹⁶ The total cost to be passed on is the sum of the expected accident costs \$5, \$10, and \$15, added to the \$15 cost of administering strict liability. The seller then must divide this total \$45 loss among 3 buyers.

⁹⁷ This is Buyer 1's utility if he waives because he then bears a 5% chance of a \$100 loss, resulting in no utility, and a 100%-5% (1-.05) chance of keeping his \$100. Note that since we have chosen to equate the possible loss with each buyers wealth, the math simplifies. This simplification, however, does not substantively alter the outcome.

⁹⁸ See *supra* note 97.

If the buyers each buy the product again, expected accident costs that the manufacturer bears if Buyers 2 and 3 purchase strict liability are now only \$25, and the Cost of Strict Liability the seller bears is \$40. Thus for the remaining two buyers, strict liability costs \$20 each. If they purchase strict liability, their total utility will be:

$$(eq. 13) U_{nowaive} = 2\sqrt{100 - 20} = 17.89 \text{ or } 8.94 \text{ each}$$

Compare this to the utility Buyer 2 and 3 would have if they each waived:

$$(eq. 14) U_{2waive} = (1 - .10)\sqrt{100} = 9.0 \quad (eq. 15) U_{3waive} = (1 - .15)\sqrt{100} = 8.5$$

From Equations 13, 14, and 15 we can see that if allowed to waive, Buyer 2 will waive and Buyer 3 will not.

Finally, if the buyers each again buy the product, the manufacturer will assume that only Buyer 3 will purchase strict liability. If only Buyer 3 purchases strict liability, the manufacturer must pass on to him his own accident costs and the \$15 cost of administering strict liability: \$30 total. If Buyer 3 purchases strict liability, his utility as the sole remaining member of the strict-liability pool will be:

$$(eq. 16) U_{nowaive} = \sqrt{100 - 30} = 8.36$$

If he waives, his utility will be:

$$(eq. 17) U_{3waive} = (1 - .15)\sqrt{100} = 8.5$$

Comparing Equation 16 to Equation 17, it is clear that now Buyer 3, and hence all buyers, will waive strict liability. As each buyer waived, it then became efficient for the next buyer to waive. In the end, the entire strict-liability pool unraveled.

Most importantly by comparing the above equations, we can see that in the aggregate ex ante, the buyers would have been better off if they all did not waive. If they all did not waive, Equation 10 shows that their total utility will be 27.65, or 9.22 each. If

the strict-liability pool unravels, and they all waive, Equations 11, 12, and 17 show that their total utility will be 27 (9.5+9+8.5). Thus, the buyers are better off in the aggregate *ex ante* if they do not waive.

In the following section, I present a more complicated, but more comprehensive, model of strict-liability unraveling, one that accounts for the variability in buyer risk as a function of precautions and for marginally decreasing administrative costs.

3. A Larger, More-Complex Unraveling Model

To more accurately observe how unraveling might occur in a waiver regime, we need a more accurate model that accounts for the ways in which costs vary. The previous two models made several simplifying assumptions: that any costs of administering strict liability do not vary with the number of buyers and that buyers' risk of injury does not vary with the precautions a seller takes. In real markets, however, these quantities obviously vary. Administrative costs of strict liability increase as the number of buyers grows.⁹⁹ As the total risk of accident loss a manufacturer bears increases, so too will the precautions he takes. As manufacturers spend more money on precautions, buyers' risk of injury from product defects will decrease. Despite these complications, the models below show that unraveling is still a concern.

Imagine a manufacturer sells products to 100 perfectly informed buyers. The manufacturer is risk neutral and thus cares only about his wealth. Each buyer has \$100 in wealth, has utility for his wealth equal to its square root ($U(W)=W^{1/2}$)¹⁰⁰, and has varied predispositions to risk of injury from defective products, which he knows.

⁹⁹ See *supra* text accompanying note 36.

¹⁰⁰ As stated earlier in the paper, consumers have a diminishing marginal utility for wealth. Defining this utility as the square root of wealth is but one possible expression (albeit a simply and easy-to-manage expression) of this relationship. See *supra* note 36 and accompanying text.

The product poses a risk R to each buyer of a \$100 loss due to injury from defective products. R for each buyer depends upon the amount the manufacturer spends making the product safer (X) and the individual buyer's characteristics (represented in this model by n). The costs of administering strict liability are represented by A , which is a function of the number of buyers B who purchase strict liability (or, stated alternatively, who do not waive). Assume that non-defective products pose no risk to buyers. The manufacturer sells the products to all 100 buyers in "rounds," such that in the first round he sells one unit to each buyer, in the second round he sells another unit to each buyer, and so on. Before each round, the manufacturer determines how many buyers will purchase strict liability so he can accordingly adjust expenditures on precautions. Then during each round, each buyer will determine whether he will purchase strict liability by comparing the utility he would have if he purchased strict liability ($U_{nowaive}$) with the utility he would have if he waived strict liability (U_{waive}). After each round, the manufacturer will again determine how to adjust his expenditures based on the new estimate of how many buyers will waive strict liability. This feedback loop will continue until it reaches an equilibrium, whereby the manufacturer's pre-round estimate of how many buyers will waive is correct, and he need make no further adjustments.

It is important before we dive too deeply into the mathematics to observe roughly how these variables relate to each other. There are two sets of relationships that will underpin unraveling in the more accurate, complex model. First, administrative costs will vary with the number of buyers who purchase strict liability. Obviously, the more buyers that purchase strict liability, the larger the total administrative costs will be. Less

obviously, the more buyers that purchase strict liability, the less the *average* cost of strict liability (the total administrative costs divided by the number of buyers who purchase strict liability). As more buyers purchase strict liability, the seller can exploit an economy of scale with respect to costs of administering strict liability.¹⁰¹ For example, the seller might need to invest a great deal of money in a lawyer to investigate the legal claims of the first injured buyer, but will be able to use this legal research in subsequent suits by injured buyers, decreasing the administrative cost for successive buyers. In economic terms, the administrative costs increase at a diminishing marginal rate as the number of buyers increases.

Second, the expected loss for each buyer due to injury from defective products varies with the amount of money the manufacturer spends making the product safer. Clearly, the expected loss for each buyer will decrease as the manufacturer spends more money on precautions.¹⁰² Also, the expected loss for each buyer will decrease at a decreasing marginal rate as the manufacturer spends more money on precautions.¹⁰³ To put this another way, for each unit of money the manufacturer spends on precautions, each buyer's expected loss from injury will decrease, but the decrease will be smaller than the decrease that resulted from the previous unit of money the manufacturer spent on precautions.¹⁰⁴ We express these relationships mathematically as follows:

¹⁰¹ See *supra* note 87 and accompanying text.

¹⁰² See SHAVELL, *supra* note 47, at 178 – 79.

¹⁰³ *Id.*

¹⁰⁴ *Id.* I generally find it difficult to describe such dynamic relationships in simple, easy-to-grasp terms, so I apologize if this point is unclear. Nevertheless, it is an important point both in this analysis and other economic analyses of law, *e.g. id.*, and worth understanding.

$$(eq. 18) \frac{dA}{dB} > 0 \quad (eq. 19) \frac{d^2 A}{dB^2} < 0 \quad (eq. 20) 0 < R < 1^{105} \quad (eq. 21) \frac{dR}{dX} < 0$$

$$(eq. 22) \frac{d^2 R}{dX^2} > 0$$

In each round of buying, the buyers will maximize their utility. The manufacturer will take precautions to minimize the sum of the costs he must pass on to the customer, which we will call the Total Cost (TC):¹⁰⁶

$$(eq. 23) TC = A(B) + X + \sum_{n=101-B}^{100} R(X, n)L^{107}$$

He will then pass on to all buyers who purchase strict liability the Cost of Strict Liability (SLC):

$$(eq. 24) SLC = A(B) + \sum_{n=101-B}^{100} R(X, n)L^{108}$$

Each buyer n will decide whether to purchase strict liability by calculating whether his utility if he purchases strict liability is greater than his utility if he waives strict liability:

$$(eq. 25) U_{nowaive} = \sqrt{100 - \frac{SLC}{B}}^{109} \quad (eq. 26) U_{waive} = (1 - R)\sqrt{100}^{110}$$

The manufacturer will then recalculate the Total Cost based on the number of buyers who waive, the buyers will recalculate their utilities of waiver and non-waiver, and so on.

¹⁰⁵ Equation 26 simply expresses that the risk R is a probability, and thus cannot be less than $0\% = 0$ or greater than $100\% = 1$.

¹⁰⁶ This assumes, for the sake of simplicity, that buyers derive such a great surplus of utility from the product that they need not consider whether to buy it, only whether to purchase or waive strict liability.

¹⁰⁷ Note that the summation begins at $n = 101 - B$. For example, initially we assume all 100 buyers will purchase strict liability ($B = 100$) we take sum of RL for buyers 1 ($101 - B$) through 100.

¹⁰⁸ Observe that the manufacturer excludes the cost of taking precautions (X) from the Cost of Strict Liability since all units, and consequently all buyers, benefit from these precautions he will pass this cost on to all buyers.

¹⁰⁹ Each buyer's utility will equal the square root of his expected wealth. If a buyer does not waive, he will definitely lose from his initial \$100 wealth his pro rata share of the Cost of Strict Liability.

¹¹⁰ If a buyer does waive strict liability, he bears a $(1-R)$ chance of ending with a wealth of \$100 (a utility of 10). Note that he also bears an R chance of ending with wealth of \$0 (utility of 0), and so we simplify the calculation by simply omitting this valueless term. *See supra* note 97.

To create the unraveling example model, we concretely define the functions in Equation 24.¹¹¹

$$(eq. 27) \quad A(B) = 70\sqrt{B} \quad (eq. 28) \quad R(X, n) = \frac{n}{X + 100}$$

Note that R is defined such that the buyers have a range of expected harm. These odds depend upon the amount the manufacturer spends on precautions *and* Buyer n 's individual propensity to risk, represented by the numerator.

Initially, assume the manufacturer estimates that all buyers will purchase strict liability.¹¹² The initial Total Cost of strict liability that the manufacturer bears, and thus wishes to minimize, is:

$$(eq. 29) \quad TC = 70\sqrt{100} + X + \sum_{n=1}^{100} \frac{100n}{X + 100} = 700 + X + \frac{505,000}{X + 100}$$

Total Cost is minimized when the cost of precautions (X) is chosen such that:

$$(eq. 30) \quad \frac{d(TC)}{dX} = 1 - \frac{505,000}{X^2 + 2X + 10,000} = 0 \quad \text{or} \quad X = 610.63$$

The Cost of Strict Liability for a buyer who does not waive it will be the sum of the average accident cost and the average cost of administering strict liability:

$$(eq. 31) \quad SLC = 70\sqrt{100} + \frac{505,000}{610.63 + 100} = 1410.64 \quad \text{or} \quad 14.12 \text{ per buyer}$$

¹¹¹ To reiterate, these functions are somewhat arbitrarily defined to obey the constraints we have placed upon them and to illustrate the unraveling phenomenon. By no means do they represent anything but one of the infinite set of possible relationships between these variables. Observe that both functions obey the conditions we have set forth for them.

$$A > 0, \quad A' = 35B^{-\frac{1}{2}} > 0, \quad A'' = -\frac{35}{2}B^{-\frac{3}{2}} < 0, \quad \frac{\partial(R)}{\partial X} = \frac{-n}{X^2 + 200X + 10,000} < 0$$

$$\frac{\partial^2(R)}{\partial X^2} = \frac{n(2X + 200)}{(X + 100)^4} > 0$$

¹¹² This is not a necessary assumption for the model. The model will still unravel even if the manufacturer estimates that many buyers will initially waive. We begin with the situation in which the manufacturer estimates that all buyers purchase strict liability to fully illustrate the unraveling model.

Buyers who purchase strict liability will have utility:

$$(eq. 32) \quad U_{nowaive} = \sqrt{100 - 14.12} = 9.27$$

If they were to waive strict liability, Buyer 51 would have a utility of 9.28, and Buyer 52 would have a utility of 9.27:

$$(eq. 33) \quad U_{51waive} = \left(1 - \frac{51}{610.63 + 100}\right) \sqrt{100} = 9.28$$

$$(eq. 34) \quad U_{52waive} = \left(1 - \frac{52}{610.63 + 100}\right) \sqrt{100} = 9.27$$

Thus Buyers 1 through 51 would waive strict liability, and Buyers 52 through 100 will purchase strict liability.¹¹³

The manufacturer's Total Cost of strict liability is now:

$$(eq. 35) \quad TC = 70\sqrt{49} + X + \sum_{n=52}^{100} \frac{100n}{X + 100} = 700 + X + \frac{372,400}{X + 100}$$

Total Cost is minimized when the seller spends X on precautions such that:

$$(eq. 36) \quad \frac{d(TC)}{dX} = 1 - \frac{372,400}{X^2 + 200X + 10,000} = 0 \quad \text{or} \quad X = 510.25$$

The Cost of Strict Liability, which the manufacturer will pass to buyers who do not waive, is:

$$(eq. 37) \quad SLC = 510.25 + \frac{372,400}{510.25 + 100} = 1,100.24 \quad \text{or} \quad 22.45 \text{ per buyer}$$

Buyers who purchase strict liability will have utility:

$$(eq. 38) \quad U_{nowaive} = \sqrt{100 - 22.45} = 8.81$$

¹¹³ Assume that buyers who derive the same utility from strict liability and from waiver will purchase strict liability. This assumption is unimportant, and in fact the opposite assumption (that in case of a tie buyers will waive strict liability) leads to the same result. To be more accurate, I could have included another decimal place in the calculations, avoiding any ties, but I chose to limit the calculations to two decimal places for reasons of space and concision.

If Buyer 72 waived, he would have utility 8.82, but if Buyer 73 waived he would have utility 8.80. Thus Buyers 1 through 72 will now waive strict liability, and Buyers 73 through 100 will not waive. Observe that now more buyers have chosen to waive strict liability.

Buyers Total Cost is now:

$$(eq. 39) \quad TC = 70\sqrt{28} + X + \sum_{n=73}^{100} \frac{100n}{X+100} = 370.41 + X + \frac{242,200}{X+100}$$

Total Cost is minimized when:

$$(eq. 40) \quad \frac{d(TC)}{dX} = 1 - \frac{242,200}{X^2 + 200X + 10,000} = 0 \quad \text{or } X = 481.66$$

The Cost of Strict Liability will be:

$$(eq. 41) \quad SLC = 370.41 + \frac{242,200}{481.66 + 100} = 786.80 \quad \text{or } 28.10 \text{ per buyer}$$

Buyers who purchase strict liability will have utility:

$$(eq. 42) \quad U_{nowaive} = \sqrt{100 - 28.10} = 8.48$$

If Buyer 88 waives strict liability, he will have a utility of 8.49, but if Buyer 89 waives strict liability, he will have a utility of 8.47. Thus, Buyers 1 through 88 will waive strict liability and Buyer 89 through 100 will not.

Now the Seller's Total Cost is:

$$(eq. 43) \quad TC = 70\sqrt{12} + X + \sum_{n=89}^{100} \frac{100n}{X+100} = 242.49 + X + \frac{113,400}{X+100}$$

Total Cost is minimized when:

$$(eq. 44) \quad \frac{d(TC)}{dX} = 1 - \frac{113,400}{X^2 + 200X + 10,000} = 0 \quad \text{or } X = 236.75$$

The Cost of Strict Liability would be:

$$(eq. 45) \quad SLC = 242.49 + \frac{113,400}{236.75 + 100} = 579.24 \quad \text{or} \quad 48.27 \text{ per buyer}$$

Buyers who purchase strict liability will have utility:

$$(eq. 46) \quad U_{\text{nowaive}} = \sqrt{100 - 48.27} = 7.19$$

If Buyer 94 waives strict liability, he will have utility of 7.20, but if Buyer 95 waives, he would have utility of 7.18. Buyers 1 through 94 will waive, but Buyers 95 through 100 will not.

Finally, the Seller's Total Cost is now:

$$(eq. 47) \quad TC = 70\sqrt{6} + X + \sum_{n=95}^{100} \frac{100n}{X + 100} = 171.46 + X + \frac{58,500}{X + 100}$$

Total Cost is minimized when:

$$(eq. 48) \quad \frac{d(TC)}{dX} = 1 - \frac{58,500}{X^2 + 200X + 10,000} \quad \text{or} \quad X = 141.87$$

The Cost of Strict Liability is:

$$(eq. 49) \quad SLC = 171.46 + \frac{58,500}{141.87 + 100} = 413.33 \quad \text{or} \quad 68.89 \text{ per buyer}$$

Buyers who purchase strict liability will have utility:

$$(eq. 50) \quad U_{\text{nowaive}} = \sqrt{100 - 68.89} = 5.58$$

If Buyer 100 waives strict liability, he will have utility of 5.86. Thus, all Buyers will now waive strict liability; the entire strict-liability pool has unraveled.

Now compare the aggregate utility buyers would derive in a no-waiver regime from the aggregate utility buyers would derive if allowed to waive. Assuming the manufacturer still spends \$141.87 on precautions (the amount he would spend on

precautions for the last pool of six buyers),¹¹⁴ aggregate utility for buyers after they have all waived is:

$$(eq. 51) \quad TotalUtility_{waive} = \sum_{n=1}^{100} \left(1 - \frac{n}{141.87 + 100} \right) \sqrt{100} = 791.21$$

In a no-waiver regime, the manufacturer would charge each buyer \$14.12 to purchase strict liability.¹¹⁵ Total aggregate buyer utility would be:

$$(eq. 52) \quad TotalUtility_{nowaive} = 100\sqrt{100 - 14.12} = 926.71$$

Obviously, the buyers are much better off in the aggregate if they are not permitted to waive strict liability. But transaction costs prevent the buyers from allocating the excess surplus utility that results from total non-waiver in a way that induces all buyers to purchase strict liability.¹¹⁶ A prohibition on waiving strict liability may be the only way to maximize social utility.

Utility-decreasing unraveling does not require a perfect, synthesized relationship between buyer risk variation, administrative costs, and precautions. Admittedly, I had to play around with the numbers and equations above a bit to provide such a nice, clear example. But unraveling theoretically can occur under a wide variety of conditions. Furthermore, the strict-liability pool need not completely unravel to diminish total social utility.

4. Summary of Strict-Liability Models

I have demonstrated how both simple and more complex strict-liability models demonstrate a potential unraveling phenomenon, which ultimately depletes buyer utility.

¹¹⁴ This calculation assumes the manufacturer has some incentive to spend even this much on precautions, for example to meet a regulatory safety requirement. The manufacturer no longer has any tort-based incentives to spend *any* money on precautions, and so the unraveling situation may be even worse than presented here. *See supra* note 46.

¹¹⁵ *See supra* p. 32.

¹¹⁶ *See supra* note 89 and accompanying text.

Yet as I commented above, constructing models in which waiver will unravel an efficient strict-liability pool may seem at first a simple task of finding the right numbers and equations. In the next section, I address arguments might limit the scope of the unraveling phenomenon's applicability.

IV. Limitations of the Unraveling Argument

The following sections address limitations of the unraveling argument and explores situations in which it might not apply. Some of these limitations draw on criticisms already made regarding a waiver system, but now we examine their application after exposing the unraveling phenomenon. Other limitations are new, unique to the waiver analysis. From these criticisms and limitations we are able to make recommendations about when the unraveling phenomenon counsels protection with a no-waiver rule.

A. Partial Unraveling of a Strict-Liability Pool

Strict-liability pools may unravel only partially, reaching an equilibrium point at which the manufacturer correctly estimates how many buyers will purchase strict liability. But even partial unraveling may be inefficient in terms of total social utility.

For example, if we decrease the administrative costs in the previous model, the strict-liability pool will only partially unravel. Rerun the previous model, but now assume administrative costs that vary with the number of buyers such that:

$$(eq. 53) \quad A = 50\sqrt{B}$$

After five rounds of buying and waiving, Buyers 1 through 70 will have waived, but the pool will unravel no further. At that point, the manufacturer's Total Cost will be:

$$(eq. 54) \quad TC = 50\sqrt{30} + X + 100 \sum_{n=71}^{100} \frac{n}{X+100} = 273.86 + X + \frac{256,500}{X+100}$$

The manufacturer's Total Cost will be minimized when:

$$(eq. 55) \quad \frac{d(TC)}{dX} = 1 - \frac{256,500}{X^2 + 200X + 10,000} = 0 \quad \text{or } X = 406.46$$

The Cost of Strict Liability will then be:

$$(eq. 56) \quad SLC = 273.86 + \frac{256,500}{406.46 + 100} = 780.32 \quad \text{or } 26.01 \text{ each}$$

Buyers who purchase strict liability will have utility:

$$(eq. 57) \quad U_{nowaive} = \sqrt{100 - 26.01} = 8.60$$

If all buyers instead waive strict liability, Buyer 70 will have utility 8.62, but Buyer 71 will have utility 8.60. Thus Buyer 70 will waive, but Buyer 71 will not. The manufacturer will not change the expenditures on precautions since he has already determined and spent the optimal amount for a strict-liability pool with 70 buyers. Again, only 70 buyers will waive. The pool will unravel no further.

Though the pool has only partially unraveled, a no-waiver regime still produces a more efficient result than a waiver regime. In a no-waiver regime, total utility will be:

$$(eq. 58) \quad TotalUtility_{nowaive} = 100\sqrt{100 - 12.11} = 937^{117}$$

In a waiver regime, if Buyers 1 through 70 waive and Buyers 71 through 100 purchase strict liability, total utility will be:

$$(eq. 59) \quad TotalUtility_{waive} = \sum_{n=1}^{70} \left(1 - \frac{n}{406.46 + 100} \right) \sqrt{10} + 30\sqrt{100 - 26.01} = 908.99$$

Thus, even when a strict-liability pool that only partially unravels, buyers can in the aggregate benefit from a no-waiver rule.

B. Small Variance in Buyer Risk

¹¹⁷ \$12.11 is the initial cost of strict liability in such a model if Manufacturer initially assumes all 100 buyers will purchase strict liability.

The unraveling phenomenon depends mainly upon a significant variance in buyer's risk of injury from defective products. Not surprisingly, when a product defect poses risks to buyers that vary only slightly from buyer to buyer, unraveling is unlikely. Even when unraveling does occur in these situations, it causes very little damage.

Unraveling is not a problem when buyers do not have varied predispositions to risk because they all act together. If buyers have identical or very similar risks of injury from product defects, they will derive very similar utilities from waiving strict liability and bearing the risk on their own.¹¹⁸ In most situations, they will all decide to waive, or all decide to purchase strict liability (depending on which yields them greater utility). If indeed they all act similarly, there is no danger that initial waiver by some will result in future waiver by others, causing an unraveling. Ex ante, they all make relatively the same efficiency decision to waive or purchase strict liability.

Observe how our earlier model with 100 buyers differs when the buyers have small variation in propensity to risk.¹¹⁹ Assume that Buyer n has a risk R_n that varies significantly less from every other buyer:

$$\text{(eq. 60) } R_n = \frac{50 + .01n}{X + 100} = \frac{5,000 + n}{100X + 10,000}$$

Note that even if the Manufacturer takes no precautions, the risk of injury from product defect all 100 buyers incur varies by only 1%.¹²⁰ Also assume that administrative costs are much smaller, as illustrated in Equation 61 below. The Manufacturer's Total Cost of strict liability if he initially believes all buyers will purchase it will be:

¹¹⁸ This presupposes that buyers have identical wealth and preferences for wealth. Of course neither of these presuppositions are true in reality, but because they do not vary with risk in a generalized, systematic way, they do not affect the unraveling analysis.

¹¹⁹ See *supra* pp. 27 - 36.

¹²⁰ If $X = 0$, then $R_1 = 50.01\%$ and $R_{100} = 51\%$.

$$(eq. 61) \quad TC = 10\sqrt{100} + X + 100 \sum_{n=1}^{100} \frac{5,000 + n}{100X + 10,000} = 10 + X + \frac{505,050}{X + 100}$$

The Manufacturer's Total Cost is minimized when:

$$(eq. 62) \quad \frac{d(TC)}{dX} = 1 - \frac{505,050}{X^2 + 200X + 10,000} = 0 \quad \text{or} \quad X = 610.67$$

Cost of Strict Liability is then:

$$(eq. 63) \quad SLC = 100 + \frac{505,050}{610.67 + 100} = 810.67 \quad \text{or} \quad 8.11 \text{ per buyer}$$

Buyers who purchase strict liability will have the following utility:

$$(eq. 64) \quad U_{\text{nowaiver}} = \sqrt{100 - 8.11} = 9.56$$

If they waive strict liability, utility for Buyers 1 and 100 will be, respectively:

$$(eq. 65) \quad U_{1\text{waive}} = \left(1 - \frac{50.01}{610.67 + 100}\right) \sqrt{100} = 9.30 \quad \text{and}$$

$$(eq. 66) \quad U_{100\text{waive}} = \left(1 - \frac{51}{610.67 + 100}\right) \sqrt{100} = 9.28$$

The utility the two buyers with the greatest variance in risk have differs only slightly.

From this model it is apparent that if given the choice, all buyers will purchase strict liability.¹²¹ Where buyers have identical or very similar predispositions to risk, a no-waiver rule may be unnecessary to prevent inefficient unraveling.¹²²

C. Buyer Lack of Information

¹²¹ Of course, we can just as easily construct a market model in which it is efficient for all buyers to waive strict liability.

¹²² However, a no-waiver rule may still be desirable to prevent freeriding. *See supra* notes 47 – 49 and accompanying text. We can imagine a homogeneous set of buyers in which each individual purchase of strict liability efficiently results in a greater corresponding increase in safety but only a lesser increase in individual safety. In a waiver regime, all such buyers would waive immediately, inefficiently incentivizing the manufacture to spend less than the optimal amount making the product safer, if he spends any money at all.

Buyers often will lack perfect information about the risk of the product they buy, particularly if they are ordinary consumers.¹²³ Whether the deficiency in buyer information will have meaningful consequences for unraveling depends upon the nature of the deficiency and its severity.

1. Buyer Obliviousness to Risk

For at least some products, buyers will be either completely oblivious to risk of harm from defective products or will so drastically underestimate this risk that it becomes irrelevant to a buyer's product analysis. When products pose a miniscule chance of harm to an individual buyer, even if this chance could result in great injury, cognitive biases lead buyers to estimate their chance of risk (and thus expected loss) to be nonexistent.¹²⁴ Additionally, if the risk of harm from defective products is sufficiently small, even commercial consumers will not have the incentives to invest the resources necessary to determine what the risk is and how to take precautions against it.¹²⁵ Thus many buyers will simply not know a product poses a risk of harm.

Where buyers are essentially oblivious to the risk of harm from product defects, mandatory strict liability (no waiver) is an essential market correction. In a waiver regime, buyers will not purchase strict liability because if they estimate the risk of harm to be nonexistent, then they will erroneously perceive strict liability as worthless. Without liability for accidents, firms have little incentive to take precautions; indeed they

¹²³ See *supra* notes 60 – 63 and accompanying text.

¹²⁴ See Ausness, *supra* note 51, at 317; see, e.g., Jon D. Hanson & Kyle D. Logue, *The Costs of Cigarettes: The Economic Case for Ex Post Incentive-Based Regulation*, 107 YALE L.J. 1163, 1186 – 88, 1197 (1998) (explaining how even people who overestimate the health risks of smoking will still underestimate their own chance of suffering smoking-related harm).

¹²⁵ E.g., WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF TORT LAW* 281 (1987).

may not have incentives to take any precautions at all.¹²⁶ Consequently, sellers will merely sell an overly dangerous product, and buyers will unknowingly bear this risk.

A no-waiver regime provides a sensible solution. With a no-waiver rule, we know that sellers will take optimal precautions, and buyers will engage in the optimal amount of activity.¹²⁷ Also, the biggest problem with a no-waiver regime—that it prevents buyers from bearing risk even if they can do so more cheaply than sellers—is not a concern in the case in which buyers are oblivious to risk. In this case, buyers would see no value in taking precautions (since they would not perceive any corresponding benefit to welfare), and it seems unlikely a buyer oblivious of risks would know what precautions to take. In markets where buyers will be oblivious to risk of injury from product defects, a mandatory strict-liability rule is desirable.

2. Buyer Misperception of Risk

Even if buyers realize that a product may be defective and thus pose some risk to them of harm, they may not properly estimate this risk, especially if they are consumers. As a group, buyers may underestimate or overestimate the risk from products.¹²⁸ Or buyers' estimates of risk might deviate from actual risks in different directions and by

¹²⁶ SHAVELL, *supra* note 11, at 53. *But see supra* note 46.

¹²⁷ Sellers will take optimal precautions since they bear both the cost of accidents and precautions and will thus spend the amount that minimizes the sum of these two costs (the optimal amount). *See* SHAVELL, *supra* note 11. Buyers who are oblivious to risk and thus do not realize that they internalize it otherwise now must clearly internalize the risk since they pay for it as part of the product's price (since sellers will pass on to buyers the average expected accident loss from a product). *Id.* They will thus purchase these products only up until the point at which their utility for them shrinks to less than the price they pay for them (the optimal amount of product use). *See id.* at 53 - 54. Of course if buyers can take precautions to mitigate or avoid harm from defective products, we might want to choose a rule that places strict liability on sellers, but allows them to defend this cause of action by demonstrating that the buyer was contributorily negligent. *See id.* Whether buyers can or can't reasonably take precautions, some kind of unwaivable liability rule may be necessary to prevent unraveling.

¹²⁸ *See* SHAVELL, *supra* note 11, at 53; Stuntz, *supra* note 60, at 1127. There is debate about whether consumer misperception of risk either generally tends toward underestimation or is unpredictable and thus requires our agnosticism. *Compare* SHAVELL, *supra* note 11, at 53 - 54 (describing the consequences of both situations in which consumers overestimate and underestimate risk), *with* GUIDO CALABRESI, *THE COSTS OF ACCIDENTS: A LEGAL AND ECONOMIC ANALYSIS* 163 (1970) (add parenthetical).

varying amounts.¹²⁹ Generally, there are an infinite number of ways in which buyer estimates of risk might deviate from the actual risk.

The unraveling consequences of buyer misperception of risk depend upon the nature of the misperception. As expected, sets of buyers that underestimate their risk of injury cause unraveling to occur more rapidly than do sets of buyers that correctly estimate their risk of injury. Buyers who overestimate their risk may also cause unraveling, albeit more slowly than buyers with perfect information. Sets of buyers that individually deviate to different degrees and in different directions from their own risk assessment behave like combinations of the two aforementioned sets of buyers, and thus it is illuminating to begin with models of those sets of buyers.

Sets of buyers that underestimate their own predisposition to risk will cause unraveling to occur more rapidly than will sets of buyers that accurately estimate their predisposition to risk. Recall our earlier model with 100 buyers.¹³⁰ Consider an identical situation,¹³¹ but now each buyer n underestimates his own risk (UR_n) by 20% of his real risk (R_n):

$$\text{(eq. 67) } UR_n = .8R_n$$

As before, the Total Cost that the manufacturer now incurs as a result of strict liability is:

$$\text{(eq. 68) } TC = 70\sqrt{100} + X + 100 \sum_{n=1}^{100} \frac{n}{X+100} = 700 + X + \frac{505,000}{X+100}$$

¹²⁹ See *supra* note 128.

¹³⁰ See *supra* pp. 27 – 36.

¹³¹ Buyers have a $\frac{n}{X+100}$ chance of \$100 loss if the manufacturer spends \$X on precautions, have a utility for wealth of $U = \sqrt{W}$, and are either given the opportunity to purchase strict liability—in which case they must pay for the average expected accident cost and administrative cost—or waive strict liability.

Total Cost is minimized when:

$$(eq. 69) \quad \frac{d(TC)}{dX} = 1 - \frac{505,000}{X^2 + 200X + 10,000} = 0 \quad \text{or } X = 610.63$$

The Cost of Strict Liability is:

$$(eq. 70) \quad SLC = 700 + \frac{505,000}{610.63 + 100} = 1410.64 \quad \text{or } 14.11 \text{ per buyer}$$

Buyers who purchase strict liability will have utility:

$$(eq. 71) \quad U_{\text{nowaiver}} = \sqrt{100 - 14.11} = 9.27$$

Buyers in this set who underestimate their risk will perceive their utility to be:

$$(eq. 72) \quad U_{\text{waiver}} = \left(1 - .8 \frac{n}{610.63 + 100}\right) \sqrt{100}^{132}$$

From this set of buyers, Buyer 64 perceives his utility to be 9.28, but Buyer 65 perceives his utility to be 9.27. Thus Buyers 1 through 64 will waive, but Buyers 65 through 100 will not.

As expected, sets of buyers who underestimate their risk of injury will be more willing to waive strict liability and will thus unravel more rapidly. Compare this first round of buying with the first round of purchase and waivers by buyers who accurately perceive their risk.¹³³ If buyers were to accurately perceive their risk, initially only Buyers 1 through 51 would waive.¹³⁴ In the same model, but with a set of buyers who underestimate their risk by 20%, Buyers 1 through 64 initially waive. Where buyers accurately perceive risk, all buyers would have left the pool after four rounds of buying

¹³² Note how buyers in this set inaccurately discount their actual risk of injury by 20%: they multiply their risk by .8.

¹³³ See *supra* p. 33.

¹³⁴ See *supra* p. 33.

and waiving.¹³⁵ Where buyers underestimate their risk, all buyers will waive after only two more rounds of buying. Unraveling is an even more powerful problem when buyers underestimate their risk of injury from product defects.

Conversely, sets of buyers that overestimate their predisposition will unravel more slowly, and are more likely to unravel only partially than sets of buyers that accurately estimate their predisposition to risk. Take the same model as above, but now assume that the set of buyers overestimates their risk by 20%. Recall that initially, their utility if they purchase strict liability will be 9.27. This set of buyers perceives that their utility if they waive will be:

$$(eq. 73) \quad U_{waiver} = \left(1 - 1.2 \frac{n}{610.63 + 100} \right) \sqrt{100}$$

In this set, Buyer 42 will estimate his utility to be 9.29, but Buyer 43 will estimate his utility to be 9.27. Thus Buyers 1 through 42 will waive, but Buyers 43 through 100 will not.

Compare this to the model of buyers who accurately perceive their risk. If buyers accurately perceive their risk, Buyers 1 through 52 will initially waive. If buyers overestimate their risk, only Buyers 1 through 42 will initially waive. Eventually, a set of buyers in this model that correctly estimates its risk will completely unravel. However, a set of buyers in this model that overestimates its risk will only partially unravel; after five rounds of buying, Buyers 1 through 66 will waive strict liability, but the pool will not unravel further. Buyers who overestimate their risk will unravel more slowly, and are less likely to completely unravel, than buyers who correctly assess their risk.

¹³⁵ See *supra* pp. 27 – 36.

We can use the two models above to predict what will happen when buyers individually deviate in their risk estimations from their true risk but as a group estimate their risk accurately on average. Imagine a model similar to those above, but this time with two sets of 100 buyers: Set Y and Set Z. Buyer n in Set Y underestimates his risk of loss at 80% (R_{Yn}) of his actual risk of loss (R_n), and Buyer n in Set Z overestimates his risk of loss at 120% (R_{Zn}) of his actual risk of loss (R_n). Note that their average assessment of risk is equal to their actual risk of loss.¹³⁶

The Total Cost the Manufacturer now incurs as a result of strict liability is:

$$(eq. 74) \quad TC = 70\sqrt{B_Y + B_Z} + X + 100 \sum_{n=101-B_Y}^{100} \frac{n}{X+100} + 100 \sum_{n=101-B_Z}^{100} \frac{n}{X+100} \quad ^{137}$$

As in the earlier model, assume the Manufacturer plans for all 200 to purchase strict liability.¹³⁸ The initial Total Cost will be:

$$(eq. 75) \quad TC = 70\sqrt{100+100} + X + 100 \sum_{n=1}^{100} \frac{n}{X+100} + 100 \sum_{n=1}^{100} \frac{n}{X+100} =$$

$$989.95 + X + \frac{1,010,000}{X+100}$$

Total Cost is minimized when:

$$(eq. 76) \quad \frac{d(TC)}{dX} = 1 - \frac{1,010,000}{X^2 + 200X + 10,000} = 0 \quad \text{or} \quad X = 904.99$$

The Cost of Strict Liability is then:

$$(eq. 77) \quad SLC = 989.95 + \frac{1,010,000}{904.99 + 100} = 1951.95 \quad \text{or} \quad 9.76 \text{ per buyer}$$

¹³⁶ $\frac{R_{Yn} + R_{Zn}}{2} = \frac{.8R_n + 1.2R_n}{2} = R_n$.

¹³⁷ B_Y and B_Z are the numbers of buyers in Set Y and Set Z, respectively, that purchase strict liability. Also recall that the summation properly begins at $n = 101 - B$. See *supra* note 107.

¹³⁸ See *supra* note 112.

Those buyers from both sets who purchase strict liability will have utility:

$$(eq. 78) \quad U_{nowaiver} = \sqrt{100 - 9.76} = 9.50$$

Buyers from Set Y who waive will perceive their utility to be:

$$(eq. 79) \quad U_{Ywaiver} = \left(1 - .8 \frac{n}{904.99 + 100}\right) \sqrt{100}^{139}$$

From Set Y, Buyer 62 perceives his utility to be 9.48, but Buyer 63 perceives his utility to be 9.50. So from Set Y, Buyers 1 through 62 will waive strict liability, and Buyers 63 through 100 will purchase strict liability. Buyers from Set Z who waive will perceive their utility to be:

$$(eq. 80) \quad U_{Zwaiver} = \left(1 - 1.2 \frac{n}{904.99 + 100}\right) \sqrt{100}$$

From Set Z, Buyer 41 will have utility of 9.51 if he waives, but Buyer 42 will have utility of 9.50 if he waives. Thus from Set Z, Buyers 1 through 41 will waive and Buyers 42 through 100 will not.

The Manufacturer's Total Cost of strict liability is now:

$$(eq. 81) \quad TC = 70\sqrt{38 + 59} + X + 100 \sum_{n=63}^{100} \frac{n}{X + 100} + 100 \sum_{n=42}^{100} \frac{n}{X + 100} =$$

$$689.42 + X + \frac{728,600}{X + 100}$$

The Total Cost is minimized when:

$$(eq. 82) \quad \frac{d(TC)}{dX} = 1 - \frac{728,600}{X^2 + 200X + 10,000} = 0 \quad \text{or} \quad X = 753.58$$

The Cost of Strict Liability is:

¹³⁹ Notice that they erroneously estimate their chance of loss to be 80% of the actual chance.

$$(eq. 83) \quad SLC = 689.42 + \frac{728,600}{753.58 + 100} = 1543.00 \quad \text{or } 15.91 \text{ per buyer}$$

Any buyer who purchases strict liability will have utility:

$$(eq. 84) \quad U_{\text{nowaiver}} = \sqrt{100 - 15.91} = 9.17$$

Buyers from Set Y who waive strict liability will perceive their utility to be:

$$(eq. 85) \quad U_{Y\text{waiver}} = \left(1 - .8 \frac{n}{753.58 + 100}\right) \sqrt{100}$$

From Set Y, Buyer 88 will perceive his utility to be 9.18 if he waives, but Buyer 89 will perceive his utility to be 9.17 if he waives. Thus from Set Y, Buyers 1 through 88 will waive, and Buyers 89 through 100 will not waive. Buyers from Set Z who waive strict liability will perceive their utility to be:

$$(eq. 86) \quad U_{Z\text{waiver}} = \left(1 - 1.2 \frac{n}{753.58 + 100}\right) \sqrt{100}$$

From Set Z, Buyer 58 will perceive his utility to be 9.18, and Buyer 59 will perceive his utility to be 9.17. Thus from Set Z, Buyers 1 through 58 will now waive, and Buyers 59 through 100 will still purchase strict liability.

As in the other models, buyers in this model lose utility because of unraveling. After three more rounds of buying, Buyers 1 through 99 from Set Y and Buyers 1 through 66 from Set Z will waive strict liability, but the pool will unravel no further.¹⁴⁰ Given that at this point the manufacturer will spend \$442.13 on precautions and that the Cost of Strict Liability for those buyers who purchase it will be \$27.32, the total aggregate utility is:

¹⁴⁰ The pool has unraveled more slowly and less completely than in earlier examples since there are twice as many buyers in this model.

$$(eq. 87) \text{ TotalUtility}_{waive} = 35\sqrt{100 - 27.32} + \sum_{n=1}^{99} \left(1 - \frac{n}{442.13 + 100}\right) \sqrt{100} +$$

$$\sum_{n=1}^{66} \left(1 - \frac{n}{442.13 + 100}\right) \sqrt{100} = 1816.29$$

Compare this with the total utility buyers would have if forced to purchase strict liability, recalling from Equation 47 that each buyer would have a utility of 9.50 if they initially purchased strict liability:

$$(eq. 88) \text{ TotalUtility}_{nowaive} = 20 \times 9.50 = 1900$$

We can see how in this combined model a waiver regime leads to an inefficient result.

Thus, buyers with imperfect information do not escape the unraveling problem. Pools of buyers may waive and unravel at different rates depending on how they perceive, or misperceive, their risk. Generally though, a waiver regime where buyers misperceive risk may still be less efficient than a non-waiver regime because of unraveling.

D. Commercial Buyers

Commercial buyers are different than ordinary consumers. Commercial buyers will often have the ability to negotiate detailed, thorough contracts with manufacturers.¹⁴¹ This distinction mitigates the unraveling problem.

Unraveling depends upon a manufacturer's inability to discern the risk of an individual buyer. Sellers may be able to distinguish between commercial buyers and tailor waiver agreements specifically to each buyer. And sellers may even be able to make different product lines for different commercial buyers, spending different optimal amounts on precautions depending upon each buyer's preferences for or predisposition to

¹⁴¹ See, e.g., Richard A. Mann & Barry S. Roberts, *The Applicability of Tort Law to Commercial Buyers*, 79 NEB. L. REV. 215, 248 - 49 (2000).

risk (or the predisposition to risk of their own customers). Thus, unraveling is of significantly less concern in the case of commercial buyers.

E. Bilateral Contributions to Risk

Thus far we have considered only models in which buyers can't mitigate their risk of injury from defective products.¹⁴² The assumption of unilateral contribution to precautions might be the most accurate model of strict liability for product defects,¹⁴³ but given that there are at least some markets in which buyers can contribute to precautions,¹⁴⁴ considering a bilateral model is worthwhile. As I illustrate below, bilateral models are more complicated and fact specific. Whether unraveling causes efficiency problems for a given strict-liability market will vary by market.

1. Markets in Which Either Manufacturers or Buyers Can Take Precautions

In some markets, either the manufacturer or the buyer can take precautions against harm from defective product, but not both. For example, commercial buyers may have the ability to take the same precautions as commercial sellers. Either the seller or the buyer will take them but not both.

In such markets, unraveling be a concern, depending on the buyers' abilities to take precautions. Like buyers' risk of product injury, buyers' ability to take precautions will likely vary as well. If the variation is such that still all or nearly all of the buyers can make the product safer than the seller can, or if the variation is such that no buyer or only a few buyers can make the product safer than the seller, unraveling will not be a problem. All, or nearly all, buyers will waive strict liability (in the former case) or purchase strict liability (in the latter), and only any remaining few must bear the burden of inefficiency.

¹⁴² See *supra* p. 11.

¹⁴³ See SHAVELL, *supra* note 11.

¹⁴⁴ See *supra* p. 15.

This situation is similar to that in which buyers' risk of injury does not widely vary. Unraveling is not a concern where initially all, or nearly all, buyers make the same decision to waive or not.

If, however, there is a wide variety in ability to make products safer, the strict-liability pool may inefficiently unravel. Generally, unraveling is a problem when the difference in buyer utility from waiver varies and is greater for some non-trivial number of buyers if they waive and greater for some other non-trivial number of buyers if they purchase strict liability. It is irrelevant whether the variation in buyer utility results from a differentiated ability to take precautions rather than a differentiated predisposition to risk. Where buyers have widely varying abilities to take precautions on their own, a no-waiver regime may be necessary to prevent inefficient unraveling.

2. If Both Buyer and Seller Can Take Precautions

In some markets, the buyer and seller can take independent precautions to mitigate risk. For example, a manufacturer might be able to invest money in precautions to make a product safer, and a buyer might then be able to invest effort in using the product safely. Unlike the precautions above, the manufacturers' efforts here are not dependent on, nor do they interact with, the buyers' efforts.

If the buyer can take precautions completely independently of the seller, then the analysis reverts back to that for the unilateral model. Buyers will take precautions, if efficient to do so, and this is wholly unrelated to what the seller does. The buyers will then decide to waive strict liability based on the considerations in the above models, namely whether they individually find it desirable to pay the seller to bear the risk of accident loss from defective products. Because the situation in which buyer precautions

are completely independent of seller precautions is identical for purposes of unraveling analyses to that of the unilateral accident model, we can see that unraveling may be a problem in such markets.

3. Summary of Unraveling and the Bilateral Model

Consideration of bilateral models supports the argument for a no-waiver regime. In the bilateral model, whether a waiver regime will result in inefficient unraveling is somewhat fact specific and perhaps not conducive to governance by clear rules. But courts are in a poor position to assess the complex parameters of a market that might indicate whether unraveling is a potential problem. Courts' inability to assess these complex parameters, combined with the likelihood that the unilateral model probably better models product defects anyway,¹⁴⁵ supports a clear and simple no-waiver regime.

VI. Conclusion

Intuition about the benefits of a waiver regime may be myopic. Intuitively, allowing buyers to waive their power to hold sellers strictly liable for personal injury from defective products seems efficient. It would seem that if buyers know their own preferences, and in some instances can better bear risk and take precautions than the seller, we should allow them to take advantage of the apparent economic efficiency of waiver. However, thus far intuition has failed to reveal that allowing large groups of rational buyers with varied expected loss from product defects may prove inefficient since the unraveling phenomenon, which we explored, may progressively cause all buyers eventually to waive strict liability, even though they will be better off in the aggregate ex ante if they did not. Our intuition may have failed us.

¹⁴⁵ See SHAVELL, *supra* note 11, at 60. Indeed, a primary justification for strict liability is that manufacturers are generally better able to take precautions against the risk of injury from defective products than buyers. See *supra* pp. 7 – 9.

Unraveling argues powerfully for a no-waiver regime. Strict-liability pools unravel because of variation in buyers' risk of injury and the marginally decreasing cost of administering strict liability. If given an opportunity to waive strict liability, the lower-risk buyers will do so. When the lower-risk buyers waive, the average accident costs rise, as does the average cost of administering strict liability, and another group of buyers will find it efficient to waive strict liability. The iteration whereby the price of strict liability increases and more buyers waive continues, until only a small pool of buyers, if any, remains. Buyers will be worse off in the aggregate ex ante, but are powerless to prevent the unraveling. They need a no-waiver rule to correct for this market failure.

Unraveling does not seem limited to a few, unique markets. In this article, we explored several different economic models of strict liability and how each might possibly unravel. Many of them predicted unraveling problems. Only when buyers had identical or nearly identical risk of injury from product defects does unraveling seem unproblematic. Nearly all other markets seem vulnerable to unraveling.

Thus, a no-waiver regime is desirable to prevent buyers from helplessly falling victim to an inefficient unraveling strict-liability pool. As our models evidence, a no-waiver regime is more efficient than a waiver regime in almost every circumstance. Furthermore, a no-waiver regime is probably sensible as an all-encompassing rule since searching for the few, dispersed markets in which unraveling is not a problem (those in which buyers have homogenous risks of injury from defective products) might be a Sisyphean task. Other advantages of a no-waiver rule are its clarity – since it does not require any assessment of bargaining equality, unconscionability, or any other barrier to

agreement – and it requires no change in the law, since it is already the rule in most jurisdictions.

A no-waiver rule might be inappropriate for some discreet markets. Markets in which buyers have homogeneous predisposition to risk of injury from accidents do not pose an unraveling danger. Also, markets in which buyers negotiate their own waiver agreements with sellers that reflect their individual predisposition to risk are not vulnerable to unraveling. Where courts or legislatures can identify and distinguish these discreet markets, allowing waiver might be more efficient.

Generally, however, most markets are vulnerable to unraveling. And courts are in poor positions to identify the parameters that might preclude unraveling in a particular market. Thus, a no-waiver regime is necessary to ensure buyers don't fall victim to inefficiency.