Lecture – Safety Regulation and Value of a Statistical Life

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1 Risk and Safety Regulation

- We have so far studied risk as an individual-level consumer problem. But is also a societal problem.
- How much risk should we subject ourselves to? Alternatively, how much safety should we demand? And how much are we willing to pay for it?
- Let's be clear: safety is a 'good' and we buy it by giving up other things (time, adventure, money, convenience). The notion that 'the more safety the better' (or "safety first") is not a sound economic concept. Ultimately, there is an optimal level of safety (for an individual or a society) and we could consume either too little or too much.
- We will take three angles of attack on this question.

1. We'll first consider product safety and liability law. Some very simple models establish how the market might optimally make choices about safe products, and how the legal regime (specifically, liability law) affects the level of safety provided by the market and who bears the cost.
2. We'll next consider reasons why the market might not provide the optimal level of safety, and consider possible public policy responses to these 'market failures.' These include:
   (a) Private mechanisms (these are actually a market response) including information provision, warranties and reputation
   (b) Licensing requirements
   (c) Facilitating provision of information
   (d) Requiring provision of information
   (e) Establishing legal liability standards
   (f) Limiting or banning products

3. We'll finally consider a fascinating empirical evaluation of the willingness of society to pay for safety (at the margin). This is the paper by Ashenfelter and Greestone, "Using Mandated Speed Limits to Measure the Value of a Statistical Life."

2 Legal liability

- It's useful to start with a few simple legal concepts.
- Let's say that there is a product that gives utility $U > 0$ and has probability $p > 0$ of harming the buyer with monetized damages of $d > 0$.
- Should the manufacturer make the product safer? It depends on the manufacturer's cost.
- Assume the manufacturer's cost is $b > 0$. Clearly, if $b < p \cdot d$, economic efficiency demands that the manufacturer *should* do it. Will she?

2.1 Strict Liability

- Consider first a legal regime of **strict liability**. Here, the manufacturer is monetarily responsible for *any* harm the consumer suffers from the product, regardless of why it occurs.
- Under this regime, one of two things will occur:
  1. If $b \leq p \cdot d$, the manufacturer will make the safety modification.
  2. If $b > p \cdot d$, the manufacturer will not modify the product, but it will reimburse consumers for harms they suffer.
- Assuming the product is sold competitively, the price will be equal to

$$P = MC + \min\left[b, p \cdot d\right],$$

  where MC is the marginal cost of production (prior to the safety modification).

2.2 Caveat Emptor

- An alternate regime is 'caveat emptor' – buyer beware. Here, the buyer faces the full risk of any damage incurred.
- It is often assumed that this regime provides insufficient incentives for manufacturers to make safe products. But consider carefully.

- If the buyer is fully informed about the attributes of the product, his willingness to pay is:

$$U - p \cdot d \text{ if the product is unsafe,}$$
$$U \text{ if the product is safe,}$$

  where U is the monetized utility value of consumption.

- The profit maximizing firm will therefore find it optimal to spend b to make the product safe if $b \leq p \cdot d$. It will not spend b to make the product safe if $b > p \cdot d$.

- This outcome is identical to the strict liability case above. The efficient action occurs under either liability regime.

- If the product is safe, its equilibrium price cannot exceed U. If it is unsafe, it's equilibrium price cannot exceed $U - p \cdot d$. The price again incorporates the riskiness of the product.

2.3 Comparative negligence

- If either extreme of liability law produces the same outcome, and this outcome is efficient, why worry?

- In many cases, both victim and 'victimizer' have access to precautions that reduce the probability and magnitude of harm. For example, a manufacturer can put a blade guard on a lawn mower so that consumers can't stick their fingers in the blade while it is turning. On the other hand, consumers could spend a moment to verify that the mower is off before reaching under it.

- Consider a case where either party – the manufacturer or the consumer – can avert the loss. Their costs of abating the loss are $b_m, b_c > 0$ where m, c denote manufacturer and consumer.

- Assume we are in a *strict liability* regime.

  - Now, the manufacturer will make the product safe if $b_m < p \cdot d$ and not otherwise.
  - Let's say, however, that $b_m > p \cdot d > b_c$. It's not efficient for the manufacturer to avert the risk, but it is efficient for the consumer to do so.
  - Will the consumer avert the risk? No. Assuming that the harm, d, is fully reimbursed to the consumer, he is indifferent as to whether or not the harm occurs.
  - Therefore, although though the consumer could efficiently avoid the harm, he will not (necessarily) do so.[1]

[1] One could imagine a case where the manufacturer pays the consumer b_c to avert the harm, thereby saving the manufacturer $p \cdot d$. It is hard to imagine this contract being enforceable in practice.

- Assume we are in a *caveat emptor* regime.
  - Now, the consumer will avert the risk if $b_c < p \cdot d$ and not otherwise.
  - Let's say, however, that $b_m < b_c < p \cdot d$. It's efficient for either party to avert the risk, but it is *more* efficient for the manufacturer to do so.
  - Will the manufacturer avert the risk? Possibly.
  - The product price should still incorporate the risk associated with its use. Hence, the manufacturer may find it efficient to spend b_m and raise the price by b_c (which is what the consumer would otherwise spend to avert the risk).
  - However, it's conceivable that in this more complex case, the manufacturer would not spend b_m and the consumer would spend b_c instead.
- The general problem with liability regimes that place all of the responsibility for damages with one party or the other is that they don't necessarily provide incentives for the risk to be abated at lowest cost. The risk level could either be inefficiently high (as in the first example above) or the expenditures on risk abatement could be inefficiently high (as in the second example above).
- This motivates a regime of **Comparative Negligence** (sometimes called 'bilateral precaution'), where courts attempt to determine which party is 'more at fault' and allocate the loss to him or her.
- This idea sounds too nebulous to formalize, but Judge Learned Hand proposed a standard in 1947 that has stood the test of time. (And, as the Cooter article notes, Judge Hand framed his argument using a mathematical formula, thus endearing himself to economists in perpetuity.)
- Judge Hand found that a party is at fault for a loss if its cost of avoiding the accident was less than the resulting harm multiplied by its probability. This is exactly equivalent to our efficiency condition above. The manufacturer should avert if $b_m < p \cdot d$ and the consumer if $b_c < p \cdot d$.
- Hence, if $b_c < b_m < p \cdot d$ and the accident occurs, the consumer would be held responsible.
- Similarly, if $b_m < b_c < p \cdot d$ and the accident occurs, the manufacturer would be held responsible.
- If $b_m, b_c > p \cdot d$, then no one is at fault.
- This rule provides incentives for the lowest cost party to avert the risk, which is exactly what we want.
- Question: What if there is less than perfect enforcement, for example, the probability of legal punishment conditional on an accident occurring is $0 < \gamma < 1$?

3 The Limits of Liability

- The above examples might suggest that we can always achieve the efficient level of safety simply by using an efficient liability regime. But this is a bit far-fetched.
- There are a number of reasons why an efficient liability regime won't solve all safety problems – that is, the market will fail. The sources of market failure emanate from several closely-related issues:

  1. Transaction costs: It may be costly to exercise the liability rights given by the law:
     - Courts may make random errors. So, even if they usually get it right, they will be imperfect enforcers. In this case the liable party doesn't face the full expected cost of a loss because there is some chance of court error – meaning that the expected loss to the manufacturer is strictly less than $p \cdot d$.
     - It may be expensive to litigate, in which case, a consumer might not bring suit even if $b_m < p \cdot d$. This creates two problems. One, the consumer is not compensated for the harm. Two, the manufacturer does not face full incentives to avert the harm. [This observation is probably the genesis of class action suits.]
     - Courts may have trouble determining $p \cdot d$, b_c, b_m. This is an information gathering problem. (See below.)
  2. Information failures:
     - Often purchasers are ill-informed about the quality of products. This makes it hard for them to make optimal decisions about the costs and benefits of risk.
     - In the examples above, $p \cdot d$, b_c, b_m were understood by consumers and manufacturers. But often consumers do not know either p, d, let alone their cost of abating that risk (b_c).
     - Manufacturers may also not know the risks (and they may even face incentives not to know this information if it could be shown in court that they knew that, for example, $b_m < p \cdot d$).
     - It may also be costly to obtain accurate information about risk (think of the case of prescription drugs). This is also a transaction cost. (See above.)

- A liability regime may also want to distinguish between punishing a forbidden act and pricing a permitted act.
- A famous example: Ford Pintos sold during the early 1970s had a defect where they spilled fuel and caught fire when rear-ended at moderate speed. This design issue led to numerous burn

deaths and horrendous injuries to Pinto drivers and passengers. During litigation, it came to light that:

> Internal Ford Motor Company documents... proved that Ford knew of the weakness in the fuel tank before the vehicle was placed on the market but that a cost/benefit study was done which suggested that it would be "cheaper" for Ford to pay liability for burn deaths and injuries rather than modify the fuel tank to prevent the fires in the first place. Dowie [a reporter for *Mother Jones* magazine] showed that Ford owned a patent on a better designed gas tank at that time, but that cost and styling considerations ruled out any changes in the gas tank design of the Pinto. [Center for Auto Safety, **??**http://www.autosafety.org/ .]

- According to our criteria above, Ford may have acting efficiently. That is: $b_m > p \cdot d$. Yet, many people do not feel comfortable with viewing liability as 'the price' of causing harm. For example, it is fairly uncontroversial that a parking ticket is the 'price' of parking illegally, but this analogy only extends so far.
- In this case, we might still use regulation to avert risk even if liability provides efficient incentives.
- [It's also possible in the case of the Pinto that $b_m < p \cdot d$ but Ford believed it faced less than perfect odds of losing the court case. Say the odds of losing were equal to $\gamma < 1$. Imagine that $\gamma \cdot p \cdot d < b_m < p \cdot d$. In this case, it was profit maximizing but socially inefficient for Ford to allow the harm to occur.]

4 Policies that Ameliorate Market Failure in Provision of Risk: Some Loosely Constructed Notes

4.1 Private market responses

- One market response is information providers and specialists (e.g., *Consumer Reports,* jewelry appraisers, auto inspection services, etc.). But we suspect that there is an under-supply of this information. And we'd like them to charge marginal cost – but if you go to *www.consumerreports.org*, you will find they are not charging $P = MC$.
- Warranties provided with product (establish a liability regime for that purchase):
  - It's costly to write a warranty contract
  - It will be incomplete
  - Enforcing the warranty is expensive

  - Warranties can also give rise to moral hazard (might you abuse a product because you are not liable for harm to it or to you?).

- Brand names – the manufacturer's reputation can provide an implicit and imperfect warranty, e.g., Honda wouldn't sell an unreliable car because it would damage the brand name.

Regulation If the private market doesn't solve the problem, it may be efficient to regulate. If so, there are a number of factors that one would consider in deciding regulations:

1. *How costly is it to get the information?*
   Buying a house: you can't want to take a risk of buying a lemon so you hire a building inspector to check condition. But you can't do this with a new drug.

2. *Ease of verification*
   Some goods are purchased often, so you can determine after one or two uses whether or not it's a good product (an "experience good"). This is true for toothbrushes. It's not true for autos, drugs, etc. In these cases, it's costly to acquire the information (see above).

3. *Technological range of choice ('ease of variation')*
   Some products are intrinsically dangerous. You cannot make a 'safe' knife. In this cases, regulation may significantly diminish the value of the product.
   But some products are much safer than others even though the cost the same and have the same functionality (e.g., defectively designed portable cribs).

4. *Extent of moral hazard*
   If the product is bound to be misused if the manufacturer is liable for harm, this may increase the case for regulation. For example, if auto manufacturers were held responsible for all auto accidents, then people would drive less safely.

5. *Extent of preference for variety*
   There are some choice restrictions that government can make where almost no one will mind. For example, no one minds banning dangerous cribs. But there are some safety restrictions that limit desirable consumer choice. For example, children's pajamas are required to be made from flame retardant fabrics. These fabrics are uncomfortable to sleep in and nasty to touch.

6. *Paternalism*
   *(*This is not generally viewed as an economic criterion – though this is changing.) Government may believe that consumers should not be able to make certain choices for themselves (for example, the ban on marijuana use).

Now, consider types of regulation.

Licensing: Setting a minimum quality threshold

- Standards are frequently used in many types of trades and some professions. There are licensed contractors, barbers, dermatologists, teachers, truck drivers, etc.
- The existence of a licensing standard implicitly states that government can tell who has 'adequate' skills in their occupation.
- There is still likely to be a large continuum of quality above the licensing threshold.
- It's possible that the government may also set the standard too high (or too low). What if I'd prefer to hire an unlicensed teacher, day-care provider, carpenter at a lower price? .

Facilitating provision of information

- One way to facilitate information provision is to standardize the definition of certain terms:
  - Gas mileage
  - What you can call 'cheese'
  - Tire longevity ratings
- Standardizing product categories facilitates credibility of product information. You may be required to use the categories, but if you do, you must meet the definitions.
- This type of regulation does not substantially restrict the range of consumer choice.
- In many cases, it may be a relatively efficient policy

Requiring information to be provided

- Next Step: Require the information be provided – e.g. the mileage of a new car.
- But doesn't market provide the incentive to provide this information so that certain manufacturers can capitalize on it?
- Would there be "low tar" cigarettes sold without the FDA?
- The government does not set standards for computer processor speed, memory capacity, hard drive space, monitor quality, etc. But this information is readily provided and there is substantial agreement on its validity and usefulness.

Legal liability

- We've discussed this above. A few fine points...
- Liability regimes generally trade off manufacturers' versus users' incentives to take care with a product.
- The more liability is distributed to manufacturer, the less incentive the user has to be careful.
- For better or worse, we seem to be moving towards a strict liability standard on U.S.
- Today you pay 50% of the price of a ladder in liability insurance. (A stylized fact)
- Some argue that liability is the most efficient way of providing health insurance: at least ladder users are paying ladder accident insurance.
- The problem with this argument is moral hazard. If people are insured by manufacturers for the harms they inflict on themselves by misusing products, they are probably more likely to suffer these harms.
- Although some would have predicted otherwise, strict liability does not seem to reduce litigation.
- One liability problem is proving connection between product and injury, e.g. did smoking *cause* you to have cancer?
- If it's hard to prove liability ex post, there may be more reason to regulate the product up front.
- But the negligence standard creates an incentive for the manufacturers to not know about the dangers of their products. i.e., cigarette companies would rather not figure out that their products cause cancer. So, if negligence is defined by knowing that your product is dangerous then you might not test it.
- Liability also restricts range of choices available because many products may not come to market due to uncertainty or cost of potential liability

Limiting or banning certain products

- What are the arguments for banning products altogether?
- Externality arguments: you don't have adequate incentive not to buy dangerous products that might hurt me, e.g., houses that burn down easily and set neighborhoods or fire.
- Information conservation arguments:

  - Instead of regulating over the counter medications, you could simply provide complete information on the label.
  - But it would be very costly for consumers to use this information (they would need a medical degree).
  - It may be efficient for the government to study the best available information and then only permit certain products
  - This yields a loss of consumer choice but it economizes on information processing

- On the other hand: some reasonable products are banned because some people have misused them.
  - For example, diving boards are almost completely gone from most public pools (more liability than regulation).
  - For parts of the 1970s, cars were engineered so that they could not be started if a passenger was not wearing his/her seat belt.

- The regulatory process is itself costly, e.g. drug certification. Results in development of fewer drugs. Creates huge fixed assets

- Also, 'safe/unsafe' is an arbitrary distinction. There is a continuum.

- AIDS drugs changed the public's thinking about the costs and benefits of allowing dangerous drugs to be sold prior to full testing.

- There are also large transactions costs associated with the prescription system, e.g. every time I want to get my kids a dose of penicillin for an ear infection, I need to make a $125 doctor's visit.

5 Estimating the Statistical Value of a Human Life

- This is a topic that makes non-economists uncomfortable. But for policy analysis, there is no way around it. How much should society spend, at the margin, to save a 'statistical life?'

- A statistical life is a probabilistic concept. When we save a statistical life, we reduce the number of deaths by one *in expectation.* The value of a statistical life (VSL) is clearly very different from what we would spend to save a specific individual who was in grave danger of death.

- It is enormously important to have some knowledge of the Value of a Statistical Life (VSL). In general, the society should undertake projects that cost less than the VSL per life saved and should not undertake projects that cost more than the VSL per life saved.

- There is no 'correct' answer to the value of a statistical life. This value is something that arises out of peoples' preferences (and their wealth). The only thing that is certain is that the value of a statistical life is not infinite.

- How do you get a credible estimate of the VSL? Not easy. Asking people will not be very informative (they'll be horrified). But the axiom of Revealed Preference says that we can observe the VSL from the choices people (or governments) make between cost and safety.

- Speed limits are one place where that choice is very apparent. The faster people drive, the less time they spend getting from place to place. Since time has value, going slower is costly in foregone opportunities. However, going faster increases the probability of death.

5.1 Context

- Prior to 1973, speed limits in the U.S. were set by states. There was no national speed limit.

- With the oil crisis in 1973, the federal government imposed a national speed limit of 55 MPH.

- Although this was probably not the intention, highway fatalities fell 15 percent the following year (nearly $10,000$ fatalities).

- [Fatalities were also trending downward before and after 1973. This may in large part reflect advances in auto safety.]

- In 1987, with oil prices low, the federal government allowed states to raise their speed limits to 65 MPH if they wished to.

- 37 states raised their speed limits in 1987 and 3 more did so in 1988.

- It's critical for the research design that *not all* states raised their speed limits. If they had, the revealed preference argument would not be plausible.

5.2 Research design

- There is a lot of technical material in the paper but the essential research design is straightforward.

- Contrast the change in fatalities in adopting versus non-adopting states.

- Contrast the change in actual speeds traveled in adopting versus non-adopting states.

- These two contrasts provide an estimate of the hours saved in driving time per statistical life lost.

- Now, multiply time saved by some monetary value per hour to obtain an estimate of the VSL. Ashenfelter and Greenstone use the state mean wage as the value of an hour saved. We can discuss in class whether this is appropriate.

- A&G refer to their approach as an 'instrumental variables' estimation, and this is one valid way to interpret it. The adoption of the higher speed limit raises speed (the endogenous variable) and raises fatalities (the outcome variable) by raising speed but probably does not affect fatalities through any channel other than speed.

- What's unusual about the setup is that the decision to 'take-up' the higher speed-limit is *chosen* by states – it is not randomly assigned (this is unlike a conventional IV).

- The choice aspect is crucial for interpreting the results through the lens of Revealed Preference. Revealed Preference allows us to say that any state that *chose* to take up the higher speed limit *must* have valued the time savings at greater than or equal to the lives lost (otherwise, by Revealed Preference, it would not have made this choice). If this time savings was \$1 million per life lost, then the VSL could be no higher than \$1 million.

- There is also an important discussion in the paper of whether political decision making about speed limits is efficient. It's crucial to the interpretation to know whether:

  - Legislators roughly understood the trade-offs between time-savings and safety when deciding on the speed limit
  - Legislators' choices roughly represent the preferences of 'average' citizens ("the median voter") rather than of some interest group that has very different preferences about the VSL.

- Why isn't it enough to assume that individuals optimally choose their speed as a function of time savings and safety?

5.3 Theoretical framework

- See figures drawn in class.

- States face a Production Possibility Frontier in Time Saved-Lives Saved space.

- They want to choose their most preferred point on this frontier

- If the speed limit is capped at 55 MPH, states may not be able to select their optimal point on the PPF.

- The 1987 law expands the feasible choice set.
- For states that choose to move to the new location on the PPF, we can say that this point is Revealed Preferred to the old location.
- We can observe the gains they make in time savings and the loss of life as they make this movement. That forms the basis for our calculations

6 Results

See:

- Figure 1
- Figure 3
- Figure 4
- Table 1
- Table 2
- Table 3 (bottom row)
- Table 4 (bottom row)
- Table 6 (panel A)
- Table 7