

# *Extending the Theory to Meet the Practice of Insurance*

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*Doth not the wise merchant in every  
adventure of danger give part to have the rest assured?*  
NICHOLAS BACON, to the Opening of Parliament, 1559

**F**ORMAL INSURANCE ARRANGEMENTS date back at least to ancient Greece. Marine loans in that era advanced money on a ship or cargo that would be repaid with substantial interest if the voyage succeeded but forfeited if the ship were lost, much like the structure of contemporary catastrophe bonds. The interest rate covered both the cost of capital and the risk of loss.<sup>1</sup> Direct insurance of sea risks, using premiums, probably started around 1300 in Belgium. The first known life insurance policy was written in 1583. By the end of the seventeenth century, sea risk insurance had evolved to a competitive process between underwriters

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1. Such arrangements are known as bottomry or respondentia bonds. Early insurance arrangements reflected poor understanding of insurance theory. For example, in 1692, England offered life annuities for sale at a fixed price, independent of age. Not surprising, healthy young people bought the policies, and the treasury lost heavily. Mortality tables had not yet been conceived. Indeed, Edmond Halley (from Halley's comet) produced the first life table in response to this event. Still, many of the modern problems had been anticipated. Understanding of moral hazard dates back to second-century Roman Palestine. For more on this and a detailed description of insurance as understood 100 years ago, see the famed eleventh edition of *The Encyclopedia Britannica* (1910).

evaluating risks in meetings at Lloyd's coffee house, the precursor to Lloyds of London.

Today, insurance is a major worldwide industry. It moves progressively into new fields. For example, health insurance was virtually unknown in the United States prior to 1929 and now pays for more than 10 percent of the U.S. GDP. Risks ranging from a camcorder breaking down to being sued for sexual harassment are all insurable events.

In recent decades, economic attention has caught up with the remarkable burgeoning of the insurance industry. This is largely attributable to the explosion in attention being paid to information in economics. Indeed, insurance so well illustrates this area that it is a major topic of introductory discussions about the role of information in economics. Moreover, the core insurance topics of moral hazard and adverse selection have been transplanted to fields such as labor economics and finance.

This sounds like a happy confluence of theory and practice growing up alongside one another: theory improves by studying practice, and practice effectively draws on the results of theory. Yet a principal theme of this paper is that perception is fundamentally wrong. We believe that there is an increasing divergence between the theory and practice of insurance. Consider the following quiz about optimal insurance.

Suppose that a risk goes from negligible to possible—for example, the increased probability of a terrorist accident on U.S. soil after September 11, 2001. Would you expect the private market to provide (a) more insurance or (b) less insurance?

A seventy-year-old unmarried woman has three children, all of whom are comfortably middle class. Would you expect her to be more likely to hold (a) an annuity or (b) life insurance?

A consumer buys a \$620 camcorder and is offered insurance in case it breaks. The insurance is for three years and costs \$120, supplementing the one-year warranty on parts and labor that comes with the camcorder. The probability of a camcorder needing a repair over three years is 8 percent (mostly in the first year), with average repair costs of \$125. Would you expect the person to (a) decline the insurance or (b) accept the insurance?<sup>2</sup>

In each case, optimal insurance principles suggest that (a) is the right answer. But (b) is the answer we often see in the world. Coverage for terrorism risk plummeted after the attacks in September 2001, despite greater demand. About seven times more elderly people have life insurance than

2. Repair costs and frequencies are from Consumer Reports (1998).

annuities, in spite of the fact that the incomes of their children are rising over time. And insurance against small-cost consumer durables is among the most profitable items sold by commercial electronics stores. For almost all products, one in five customers purchases the insurance; for some products, four in five do so.

We argue in this paper that these examples are not minor anomalies but reflect a systematic tendency for insurance in practice to differ from insurance in theory. We discuss and grade a number of insurance settings: (a) mortality, health, and property risk for individuals and (b) property, liability, environmental, and terrorism risk for businesses. In the vast majority of cases, we argue, insurance in practice diverges from insurance in theory.

The divergence is of two forms. First, insurance purchases do not match theoretical predictions. Many risks that are insured—sometimes at excessive prices—should not be, and many significant risks that should be insured are not. The case of life insurance among the elderly or insurance for minor consumer durables are examples of the former. The lack of coverage for terrorism insurance is an example of the latter. Second, there are significant mismatches between parties who should bear risk and those who actually do. Risks can be borne by public entities, by private (for-profit and not-for-profit) firms, and through financial markets. In practice, the allocation of risk across these entities seems suboptimal. Governments insure risks that the private sector might better bear, and financial markets, despite their vast resources and wide participation, are not a major bearer of large private risks.

The divergence between theory and practice is not a result of moral hazard or adverse selection. In many settings with failures, information is as close to symmetric as it is possible to be—for example, in the risk of a terrorist attack—and moral hazard is extremely implausible. Rather, we argue that the divergence of insurance theory and practice results from three phenomena: the first on the supply side, the second on the demand side, and the third a true joint product.

The first is highly incomplete diversification on the part of insurers. Investors in insurance companies may be nearly risk neutral for virtually all insurance decisions, but managers of insurance companies are not. This outcome, we believe, arises due to contracting problems on the supply side of insurance. Risks that are hard to predict, or are correlated across the insured, may lead the insurance company to lose significant amounts of

money, with some executives being blamed and losing their job.<sup>3</sup> We argue that this is an important reason why large but nontraditional risks—for example, terrorist attacks or long-term health care—are not insured.

Contracting difficulties also help to explain why financial markets, with assets in the trillions, as opposed to billions for insurance companies, have not played a more significant role in insurance. One challenge is to secure collateral from investors—the ideal source to cover claims—in case a claim arises. Catastrophe bonds are a small step in this direction, but there is no reason to use only fixed-income investments as collateral.<sup>4</sup> In time, we expect, individuals will be able to participate in insurance pools by pledging such assets as stocks and real estate. A second challenge is to marry insurance expertise with ready pools of capital. Such marriages have been highly successful in areas such as venture capital and hedge funds.<sup>5</sup> The standard financial arrangement for such contracts (a management fee and a share of profits) may not be sufficient insurance, since recorded profits on insurance may be large until an adverse event occurs, even though expected profits are small or negative. Still, there is plenty of money to write insurance and ample expertise to write the insurance effectively, even if bringing the two together will require innovative institutions and creative contracts.

The demand side contributes its share to the poor performance of insurance relative to theoretical par. The central problem is that people have severe difficulties making decisions where small probabilities and significant stakes are involved. These difficulties have been discussed in the burgeoning literature on behavioral economics and behavioral decision-making, which was pioneered by Amos Tversky and Daniel Kahneman and for which Kahneman shared the 2002 Nobel Memorial Prize in Economics. People seem (irrationally) fearful of uninsured losses. They overly project their unhappiness and regret were a bad event to occur, and they misjudge probabilities. As a result, people often insure when theory would say they should not: they insure against small risks; they take deductibles that are way too small; and they insure against events that, though tragic, do not change the marginal utility of income.

3. Insurance executive James Ament notes as well that the stock market is unforgiving of insurers that post a bad quarter.

4. Such bonds have claimed a smaller share of the market than many observers, including Warren Buffett, expected. In part, this may be the relative lack of familiarity with this instrument and the demand for high returns from the limited pool of catastrophe bond investors.

5. We judge by money raised, not investment results.

The third problem is what we refer to as probability monopoly. It arises when sellers of insurance know risks much better than buyers and when there is limited competition. Sellers then set prices well above actuarial and administrative cost so as to capitalize on the buyers' potential misestimates. Buyers who overestimate the risk of breakdown purchase insurance, at a profit for the insurer. In settings where insurance naturally follows a particular event—buying a consumer durable, for example—this possibility is magnified.

In the remainder of this paper, we develop these themes about the operation of insurance markets in theory and practice. We introduce areas where we think the theory of insurance should be extended if it is to explain practice, such as understanding what benefits actual purchasers believe they get when they purchase insurance. We start with some basics on when we expect insurance to be widespread and then turn to an evaluation of insurance markets in practice.

This is a thought piece. Thus it tries to present neither rigorous theory nor detailed empirical analysis. It draws data from many sources and arenas to illustrate its themes. And it is speculative in part to be provocative. Thus, for example, we provide our own grades for the functioning of insurance markets across many areas.

### **Insurance in Theory**

In many arenas insurance works well. We begin by examining what we might think of as par performance for insurance markets and then grade various insurance areas on how they do on these criteria.

The principal goal of insurance, as assessed by economists, is to transfer resources from states where the marginal utility of income is low to those where the marginal utility of income is high. If insurance is actuarially fair, this process will continue until the marginal utility of money is equal across states. If it is unfair, insurance will be partial, but it will be greater, the greater is risk aversion.

Insurance is most effective when losses are common enough to be of concern but not frequent enough to be routine. Neither asteroid strikes nor car scratches make for good insurable events. Insurance for routine events requires frequent administrative expense that makes the insurance less valuable; the benefits of spreading risk are also low. Insuring

extremely rare risks also involves reasonable expense, with little compensating gain.

Similarly, transaction costs make it important that risks be relatively well defined and assessable once they happen. Otherwise, the assessment and litigation of claims can be exceedingly expensive. For most familiar risks—for example, a house burning down—this condition would be met. However, the recent experience with the one- or two-incident World Trade Center catastrophe makes it clear that there are important exceptions, even with burning buildings. Such ambiguities are more likely where new classes of risk come into play.

Effective insurance also requires that unobservable actions—that is, moral hazard—not be too significant. Fortunately, major aspects of non-monetary, uncovered loss often assure that this is the case. Thus, for example, rational drivers are not likely to drive at unsafe speeds simply because they are insured, and people are unlikely to smoke because they know that, if they get cancer, they will receive treatment. The potential for death and disability in these cases influences actions at least as heavily as covered losses. Monitorable actions (for example, determining whether a building is kept in safe condition) and risks due to an external source (for example, earthquakes) also diminish the moral hazard problem.

These important attributes for effective coverage are generally positively associated with the demand for and volume of insurance. The supply side also determines how well insurance works. Two critical questions are how diversifiable is the risk and whether an entity is capable of bearing it. Most familiar insured risks—for example, the risk of death—are readily diversified cross-sectionally, since the experiences of members of large pools of the insured are effectively independent. There are, however, many critical risks—for example, the costs of common events many years into the future, such as long-term care for current sixty-year-olds—where expected costs for different individuals are strongly correlated; they are so-called aggregate risks. Cross-sectional diversification is not possible with these risks, and other risk-sharing arrangements are needed.

Concerns about the supply side may seem misplaced in an industry like insurance, where there are many firms, and barriers to entry seem relatively modest. Still, competition in insurance seems far from perfect. As one demonstration of this, consider a fundamental attribute of perfectly competitive markets: the law of one price. In a competitive market, the same good should sell at the same price everywhere.

**Table 1. Medigap Monthly Premiums for Plan C in Denver, Colorado, by Age**

U.S. dollars

<i>Firm</i>	<i>Age 65</i>	<i>Age 70</i>	<i>Age 75</i>	<i>Age 80</i>
AARP	129	129	129	129
Equitable Life	96	113	123	134
5 Star Life	52	78	58	88
Union Banker	204	230	271	326

Source: www.centuraseniors.org. Information was collected in December 2003.

Table 1 shows the price of Medigap insurance—supplemental insurance coverage that pays for the cost sharing required by Medicare—for seniors in Colorado. Medigap is an interesting market to study because the policies that can be offered are absolutely standardized, being set by the federal government. Thus there are no hidden provisions to account for. Still, the price of insurance varies by a factor of four across companies.<sup>6</sup> Even more unusual is the obvious difference in pricing strategies that firms follow. The American Association of Retired Persons (AARP) has a uniform price by age, while none of the other insurers does. In a situation where consumers shop around regularly, this would not occur.

Even businesses find it hard, or seem reluctant, to shop for the best insurance deal. Warren Buffett, one of America's shrewder insurance purveyors, announces periodically in his Berkshire Hathaway report that he will not be writing various types of business coverage this year because the rates are too low.<sup>7</sup> Buffett suggests that, despite expected losses, his competitors are writing insurance to keep their old customers, expecting these customers to stick with them when prices rise.<sup>8</sup> His competitors, at least, think cross-elasticity of demand is low for insurance.

In this section we consider a large number of potential individual and business risks and evaluate them on our criteria, effectively seeing how well they are likely to be spread. Table 2 shows our assessment. In each case that we consider, there is a disparity in marginal utility across states of nature. This is why insurance is valuable, at least from an economic standpoint. The other criteria differ in applicability across the risks.

6. Mitchell and others (1999) show a large divergence in the price of annuities across companies.

7. The insurance price cycle is one of the many divergences between theory and practice that must await future study.

8. Warren Buffett remarks that his competitors sometimes sell insurance when the premiums plus earnings from them are below expected losses. "The most important thing to do when you find yourself in a hole is to stop digging" (Buffett 1990).

**Table 2. Assessment of Insurance Possibilities**

<i>Type of risk</i>	<i>Example</i>	<i>Criteria for insurance<sup>a</sup></i>				
		<i>Disparity in marginal utility</i>	<i>Frequency of event</i>	<i>Well-defined loss</i>	<i>Importance of moral hazard</i>	<i>Ease of diversification</i>
<i>Individual risks</i>						
Survival	Life, annuities	+	+	+	+	+
Health	Short-term care	+	–	+	–	+
	Long-term care	+	+	–	–	–
Property and casualty	House, auto, consumer durables	+	+	+	0	+
<i>Business risks</i>						
Property and casualty	Short-term risks	+	+	+	0	+/-
	Long-term risks (pollution)	+	+	+	+	–
Employment	Harassment, unfair hiring practices	+	+	+	+	–
Obligations	Pensions	+	+	+	–	–

a. + indicates that the risk is favorable for insurance; – indicates that it is unfavorable for insurance; 0 indicates that it is neutral for insurance or unknown. The assessments are provided by the authors. See text for more discussion.

### *Consumer Risks*

We analyze three major consumer risks. The first is mortality. Although death is certain, its timing is not. Family-oriented breadwinners would like to insure against early departure. Thus we expect term life insurance to be a common asset in working years. Once retired, the demand should tip to annuities that guard against outliving one's assets.

Mortality risk is a classic case where we expect insurance to perform well. On the demand side, the event is obviously infrequent, so that administrative costs relative to ultimate payouts are not high. The loss is also well defined, and moral hazard is contained.<sup>9</sup> On the supply side, it is relatively easy to diversify mortality risk across people, since aggregate death rates are generally fairly stable.

The second risk is to health—more specifically, the danger of incurring medical conditions that are expensive to treat. We divide health risks into two categories. The first is short-term health risks. People have variable health needs in the current year, which conventional health insurance covers. Health risk is somewhat less conducive to insurance than is mortality risk. In part, the need for medical care is not ideal. While some health

9. Some have speculated that people live longer because they have an annuity, although we suspect that this effect is relatively minor in aggregate.

needs are truly random, others are routine, such as an annual physical or well-baby care. The costs of running payments for such services through insurance may be high. In addition, moral hazard is an issue in health care. People may (or may not) take much worse care of themselves when they have health insurance—termed *ex ante* moral hazard—but they certainly use more care when insured than when uninsured (*ex post* moral hazard); they come in more frequently for minor aches and pains. Health insurance is not run like a contingent claims market. Whatever your health condition, the more you spend, the greater the cost you impose on the insurer.<sup>10</sup>

Some health risks are also long term. Future long-term care expenses provide a salient case. About one-third of the elderly will use nursing home care on a sustained basis, and this care can be expensive: current costs are upward of \$40,000 a year.<sup>11</sup> Because a lot of the gains from long-term care insurance involve pooling people who die without using a nursing home with those who do, this care needs to be purchased before significant morbidity sets in. Risk about future health is related to long-term-care risk. Health insurance for individuals, or the groups they purchase with, is usually experience rated. Should an individual's health decline, should the health of the average member of the group decline, or should the expenses for treating particular conditions rise, the premium will increase. Thus one might expect people to insure against the risk of becoming high cost in the future.<sup>12</sup>

Adverse long-term health events are sufficiently infrequent, but not too much so, that insurance makes a good deal of sense, at least in theory. But these risks challenge conventional insurance in three other ways. As with short-term health insurance, moral hazard is likely to be an issue in long-term insurance: if grandma is insured, move her to the nursing home. In addition, the loss is poorly defined. When does a person need long-term care, and when is she capable of functioning on her own? What does an individual's health today signal about her potential future spending? These information problems undermine the viability of long-term insurance. On the supply side, there is a substantial concern about diversifying these

10. Medicare diagnosis-related group payments, which make fixed payments to providers dependent on condition, are an exception.

11. National Center for Health Statistics (2003).

12. Pauly, Kunreuther, and Hirth (1995); Cochrane (1995); Cutler (1996). Indeed, since declines in health lead earnings expectations to diminish and earnings cannot be insured, long-term health insurance is that much more valuable.

risks. When future medical costs increase for some people—for example, because expensive new medical technologies become available—they increase for others as well. Similarly, if new medical knowledge extends survival at older ages, it yields such benefits to millions. The unhappy side effect is that a much greater percentage of the population will spend a fair amount of time in a nursing home, assuming that vitality does not increase apace with survival. Such properties of long-term health risks imply that cross-sectional diversification is not entirely possible.

The final individual risk that we address is property and casualty risk. People own homes, cars, and consumer durables that may burn, crash, or break. Consequently, they may want to insure them. Property and casualty insurance has many attributes that are favorable to insurance coverage. The major exception is moral hazard. One might imagine that when people are insured, they drive faster or take less care of their house or other durables. Some evidence suggests that this is the case, although the evidence is far weaker than for moral hazard in medical care utilization.<sup>13</sup>

While mortality, health, and property-casualty risk are the major individual risks that we consider, there are other risks we are not discussing. Most people owe money on a house and face a choice between an ostensibly risky debt payment (an adjustable-rate mortgage) and a fixed, insured payment (a fixed-rate mortgage). However, it is not obvious which form should be preferred—that is, whether the borrower should protect the bank against interest rate movement or vice versa. We might analyze this financial choice in the same way as other forms of insurance. People might also like insurance for their human capital: for example, to guard against depreciation of their skills—think travel agents—or prolonged unemployment. There is public insurance for some of these risks, via unemployment insurance, workers' compensation, and disability insurance. But many risks—for example, lost productivity—are insured by no one. Moral hazard is clearly a substantial issue for many of these risks. In the interest of brevity, however, we do not consider the entire range of risks that individuals face.

### *Business Risks*

Many business risks are similar to individual risks. Businesses own property, for example, and uncertainty is associated with damage to that

13. See Cohen and Dehejia (2003) for a summary.

property. Businesses are also liable for damages if someone is injured on their premises, if they are found to cause health harms, or if their employees are mistreated. As with health risks for individuals, we divide property and casualty risks for businesses into two groups. Short-term risks are the most common type of business risk. They encompass most damage to property and exposure to litigation. Most of these risks involve relatively infrequent events (but not too infrequent) and generally have well-defined losses (the World Trade Center being a notable exception). There may be some moral hazard in these actions, but we suspect that it is not large.

Most, but not all, short-term business risks can be diversified cross-sectionally. The most prominent exception is terrorism risk, where the potential losses are so large (due to correlation in losses across the insured) that even having a substantial insurance pool does not drive the variability of losses particularly low. As a result, we note ease of diversification as being either favorable or adverse.

Long-term property and casualty risks are those risks that will not be realized for some time. Firms may discover only years later that the chemicals in their product increase the risk of cancer. In the same fashion, obstetricians may be sued years after a birth for complications that were only realized (or alleged) later. One can think of the liability revolution in the 1970s and 1980s as a bad realization of a long-tailed risk. Once again, this long-tailed risk makes diversification difficult, since new knowledge-increasing claims against one business are often correlated with increases in claims against another. Difficulties with diversification are a major problem in many long-tailed litigation risks.

Firms also face risk about employment decisions. Firms may be sued for sexual harassment, unjust dismissal, or unfair hiring practices. This risk has many of the attributes of long-term property and casualty risk. The event is not very frequent and is well defined, but it may not be diversifiable cross-sectionally. The same legal changes that made liability for pollution or medical harms greater than were thought also increased the potential losses from employment issues.

Finally, businesses have risky obligations for the pensions and health care of retired workers. Many large firms have defined-benefit pension plans, which obligate them to a specific payment based on the age of the retiree and number of years of service. Retiree health insurance payments may work the same way. If pension costs rise more rapidly than expected or a firm's earnings fall substantially, the firm may be unable to meet its

pension obligations. Moral hazard is of clear importance in this risk. Firms that are doing poorly will underfund their pensions, knowing that if the firm fails it will not have sufficient assets to pay out its pension liabilities.<sup>14</sup> Diversification issues are also important, since pension and health costs tend to rise jointly across firms. For this and other reasons (perhaps the political imperative of caring for penurious retirees), pension obligations are generally insured through the public rather than the private sector.

As with individuals, businesses might like to insure other financial risks as well. They can often do this by using sophisticated financial instruments. Companies selling abroad can hedge exchange rate risk, and businesses can insure interest rate risk through appropriate derivative securities. To keep our analysis manageable, we avoid consideration of such financial risks.

#### *Bundling Insurance and Other Services or Attributes*

Many products that are officially sold or presented as insurance provide more than just financial protection; they bundle other services with risk-spreading benefits. These additional benefits are important in evaluating the insurance policy.

In some arenas, insurance products have integrated backward into purchasing services or at least procuring them. This enables insurers to purchase products at substantially reduced rates. Health insurance is the most prominent example.<sup>15</sup> When insurance is coupled with provision, the combination may yield significant advantages in exerting leverage as a buyer. Such a

14. In a related situation, one of the authors worked for Equitable Life in the early 1960s. One task was to determine when a company had incurred a catastrophe in an accident. Excess losses would be written off, lest dividends never be paid in the future. Our naïf inquired, "Why don't our policies indicate that there will not be a payoff in case of nuclear war?" The answer was basically: "It does not matter what we say. Given a war, our losses will be too great, and our asset base significantly destroyed. We will not pay." Our second story is at a less monumental scale and in keeping with the early winter of 2003–04. The roommate of one of the authors created a company in high school to shovel snow for a flat fee for the winter, thus offering insurance to its customers. There was a big snowstorm early in December. The company announced it was going out of business and returned the money.

15. Differences in bargaining power produce significant results. Altman, Cutler, and Zeckhauser (2003) find that, for a common pool of the insured (government employees in Massachusetts), the indemnity plan pays prices 35 percent more than health maintenance organizations for the same procedure. The gap with uninsured individuals would surely be much greater. Health plans frequently pay less than half as much for prescriptions from the same pharmacy as uninsured customers. If anything, the administrative costs for insured patients are higher, since two parties have to be charged.

buying consortium should not be thought of as exclusively or even predominantly as an insurance product—that is, as a risk-spreading device.

Many insurance products couple insurance with a tax shield. The buildup in whole life insurance is not taxed, for example, making that product an excellent vehicle for saving. Health insurance that pays for the costs of routine care is also a tax haven, saving the taxation that would be associated with wage and salary payments. The primary motivation for such policies is not the financial risk per se, but the combination of risk reduction and tax rewards.

Still other insurance programs, especially in the public sector, have a strong redistributive element. Government “insurance” programs, such as Social Security and unemployment insurance, almost always have an intended redistributive role. That is, judged *ex ante*, some participants are hurt, while others are helped. But even in the private sphere, we see redistribution at play. Thus young workers usually subsidize older workers in employer-provided health insurance.

Alas, there is no way to discuss insurance without referring to instruments that work as a buying consortium and significantly redistribute income. These instruments are not strictly insurance. This caveat should inform our discussion below.

### **Insurance in Practice: Consumer Risks**

In this section, we evaluate how insurance for consumer risks fare in practice. Because we consider a number of risks, our analysis is necessarily impressionistic. We rely on conclusions of detailed research studies where possible and on analysis of aggregate data in other cases. For many types of risk, we conclude that insurance performs substantially less well than is anticipated by theory. Table 3 shows our summary.

#### *Mortality*

As Yaari first noted, life insurance and annuities cater to mutually exclusive circumstances: living too long and living too short. One would not expect the same person to want both instruments in force at the same time.<sup>16</sup>

16. Yaari (1965). Davidoff, Brown, and Diamond (2003) extend this analysis to the case of incomplete markets, with relatively similar results.

**Table 3. Evaluation of Insurance Markets**

<i>Risk</i>	<i>Example</i>	<i>Issues noted</i>	<i>Other factors</i>	<i>Overall evaluation</i>
<i>Individual risks</i>				
Mortality	Life	Underinsurance of widows; overinsurance of elderly	Tax-free buildup	Fair
Health	Annuities	Too little purchase		Poor
	Short-term care	Too much coverage for small risks	Tax subsidy	Fair
	Long-term care	Too little coverage for large risks		Poor
Property and casualty	House	Too much coverage for small risks		Good
	Auto	Too much coverage for small risks		Fair
	Consumer durables	Why do people buy?		Poor
<i>Business risks</i>				
Property and casualty	General	Good for most industries (major exception is medical malpractice)		Fair
	Long-term risk (pollution)	Inadequate coverage of large risks; market dries up with new knowledge		Poor
	Terrorism	Inadequate coverage of large risks; market dries up with new knowledge		Poor
Obligations	Pensions	Underfunding of pensions	PBGC reinsurance	Poor

Source: The assessment is based on the authors' beliefs. See text for details.

In practice, life insurance is very common, and annuitization is fairly rare. The 2001 Survey of Consumer Finances estimates that two-thirds of families have life insurance, including about 80 percent of two-adult families. In total, families have \$16 trillion of assets in life insurance.<sup>17</sup> Annuities, by contrast, are owned by only a small share of the population, usually as one option in a retirement plan, for example, with an IRA rollover. Only 8 percent of the population ages seventy and older has an annuity, while 78 percent of that group has life insurance.<sup>18</sup> Annuity reserves total less than \$2 trillion.

Without knowing individuals' preferences exactly, despite knowing their assets, earnings, and family and health status, we cannot tell what

17. American Council of Life Insurers (2003).

18. Brown (1999).

insurance arrangement is optimal for them. A married worker might skip life insurance if he does not value highly the consumption of his non-working spouse. Similarly, a couple may not want an annuity in old age if it is penurious relative to assets or if they can deal with a declining consumption stream. Still, one suspects that such cases are rare and that the large changes in consumption that individuals might experience due to lives cut short or stretched long are not intended. The research literature takes this perspective in evaluating the adequacy of annuitization and life insurance: it examines whether these products are purchased in sufficient quantity to minimize changes in consumption in the event that bad outcomes are realized. Because of the centrality of life insurance and annuities to the lively debates about social security reform, their use has been considered in detail.

**LIFE INSURANCE** The spread of life insurance is expected, valuable, and important as a source of savings as well as security. Still, two aspects of life insurance have drawn attention as being suboptimal. The first is the substantial rate of life insurance holdings among the elderly.<sup>19</sup> Some of the elderly—a group whose children are presumably independent—would rationally want life insurance protection (if pensions depend on the survival of one spouse, for example), but three-quarters is a very high share. Even many elderly without dependents have life insurance.

Some work has examined this puzzle. One proposed explanation is that social security provides too much annuitization, and people offset that by purchasing life insurance. Brown finds evidence that this is not the case, however; term life insurance is not more likely to be held by people with larger social security payments.<sup>20</sup> He suggests that other explanations are more important: tax policy that allows for tax-free buildup in whole-life insurance or tax-free payment of burial costs and inertia from purchasing life insurance earlier in life. The exact share attributable to each is not entirely known, but the nontax explanations such as status quo bias are surely important.<sup>21</sup>

The extent of life insurance during the working years seems broadly appropriate, although concerns linger. In particular, some authors worry about whether people in their working years are sufficiently insured. Recent studies suggest that too few families have life insurance, and many

19. See Brown (1999) for a review.

20. Brown (1999).

21. Samuelson and Zeckhauser (1988).

families that have insurance are underinsured. Bernheim, Forni, Gokhale, and Kotlikoff use data on family income, assets, and demographic characteristics for people ages fifty-one to sixty-one (from the Health and Retirement Survey) to examine the consumption consequences should they die.<sup>22</sup> They estimate that 30 percent of wives and 11 percent of husbands would suffer a decline in consumption of 20 percent or more if their spouse passed away. This is a large enough reduction to rule out the explanation of rational preferences, apart from the joint explanation of little concern for and insufficient bargaining power of the dependent spouse. The shortfall in insurance coverage is more surprising given government tax subsidy for employer-paid premiums and investment earnings during the life of a policy.

Work by Bernheim, Carman, Gokhale, and Kotlikoff suggests that two-thirds of poverty among widows and one-third of poverty among widowers results from a failure to purchase sufficient life insurance.<sup>23</sup> The extent of underinsurance varies with socioeconomic characteristics. After correcting for income and assets, underinsurance is more common among lower-income families and among couples with very asymmetric earnings (for example, one-earner couples). In the latter families, the death of the higher-earning spouse would often pose severe hardships for the surviving spouse.

Adverse selection could explain the underpurchase of insurance among some families, but the literature does not suggest that this factor is important in life insurance. Cawley and Philipson document that prices decrease with additional purchases, where adverse selection would imply the reverse.<sup>24</sup> They also find that individual forecasts of mortality probabilities do not predict the purchase of life insurance. Life insurance is also estimated to have very low administrative expense. More likely is that these families are simply not planning adequately for adverse events that may occur: they do not forecast the extent of consumption declines should death occur, life insurance never becomes a conscious decision the family makes, or the male decisionmaker does not weigh the utility of his spouse very highly.

**ANNUITIZATION** The central question about annuities is why so few people purchase them. As noted, less than 10 percent of people ages sev-

22. Bernheim and others (1999).

23. Bernheim and others (2001).

24. Cawley and Philipson (1999).

enty and older have a private annuity, although essentially all elderly have social security and many elderly have defined-benefit pension plans.

The administrative load in annuities provides a partial explanation. Mitchell, Poterba, Warshawsky, and Brown estimate that the load on annuities is about 15 to 20 percent.<sup>25</sup> About half of that results from adverse selection; the remainder is marketing costs, processing costs, and insurer profit.

The low rate of annuitization remains puzzling, even in light of these administrative costs. First, the investment returns in annuities are strongly tax favored. Second, concerns about risk spreading make annuities worthwhile. In a utility-based simulation model of the annuitization decision, Mitchell and his coauthors estimate that people should be willing to pay an administrative fee of 25 percent to annuitize their assets. That is far above the cost that we see in practice. Conceivably, strong bequest motives could explain low rates of purchase.<sup>26</sup> But annuities are one way to insure the size of the bequest. The literature does not explore the degree or nature of the bequest motivation. We expect that few of these results could stand up to rational economic scrutiny.

The literature speculates more about “behavioral” explanations for the low rate of annuitization. Anecdotal evidence suggests that many elderly may not be aware of or understand annuities, and many fewer have priced them (further undercutting the high-administrative-cost explanation for modest use). Other potential customers may fear paying money to an insurance company only to die shortly thereafter without much return. Along the latter lines is the seemingly inexplicable preference that some people have for annuities that guarantee a payment for a certain number of years, even if the annuitant dies before that time.

**SUMMARY** As a means of keeping track of the evidence, we provide our net assessment of the various insurance markets we consider. To keep the analysis simple, we use a three-point scale: good, fair, or poor. We recognize that this assessment is highly subjective; readers may take issue with particular values or even the scale that we use. On the basis of the evidence, we grade life insurance as fair and annuities as poor. Life insurance earns a higher grade because it functions well for many people. But in both cases

25. Mitchell and others (1999).

26. But that leaves the puzzle as to why big asset holders give away so little during their lifetime. Such gifts cut the estate tax by a third, since the gift tax, which comes out of the estate, escapes taxation within the estate.

there is some underinsurance and, in the case of life insurance, some overinsurance as well.

### *Health*

Health risk is the second major type of risk for individuals. We divide health risks into two categories: short-term risks and long-term risks.

**SHORT-TERM HEALTH CARE** About 85 percent of people in the United States have health insurance for their current medical care, according to the U.S. census. Coverage rates are greater in most other major developed nations, usually because of government involvement.

As with mortality risk, there is substantial analysis of the optimality of private health insurance contracts. The fact that not everyone has private insurance has generated policy debate and research attention. There are three typical explanations for lack of coverage. The first is administrative expense. In any market with administrative costs, we would expect less than full coverage. Administrative costs account for only about 15 percent of health insurance, however, so most analysts discount this explanation. Indeed, the true rate of administrative expense in health insurance is likely smaller, perhaps net negative, in many instances when buyer leverage is figured in. Health insurers, with their strong bargaining power in a high-fixed-cost industry, purchase specific health care goods and services much more cheaply than do individuals. Such discounts likely more than make up for administrative costs.<sup>27</sup>

Adverse selection provides a second explanation. Insurance priced for the average enrolled person can lead to an equilibrium where the healthy do not enroll. We know of no simulations about the importance of this phenomenon, but we suspect that this explanation is right for some people. Many of the uninsured are young and relatively healthy. The value of insurance priced at average rates is not very high for this group. One concern about this explanation, though, is that insurance can vary in generosity. Deductibles, services covered, and access to particular providers all vary across policies, and we might expect more of the healthy to segregate into less generous policies than to go without coverage entirely.

The third explanation is crowdout by government insurance programs (for example, Medicaid) and charitable programs (for example, hospital free care). In this theory, people do not purchase private coverage because

27. See note 12.

they know that they can receive care even if they are uninsured. Naturally, there is a loss. Being uninsured is associated with less, and less appealing, access to medical care providers, less use of preventive and acute care services, and worse health outcomes.<sup>28</sup> But it also saves money. For some people, the savings may be worth it.

Empirical evidence shows that crowdout is a factor in explaining insurance coverage. Increases in the generosity of public insurance and in uncompensated care lead more people to go uninsured.<sup>29</sup> The analysis required to explain what proportion of the uninsured this accounts for has not been undertaken, however.

Even if the level of health insurance were appropriate, one might question the mix of provision between public and private. Insurance has a surprising mixture of such provision: the pattern is hardly in line with notions of comparative advantage across sectors. In the case of health insurance, some argue for public insurance, on the grounds that administrative costs are lower in public programs than in private policies.<sup>30</sup> Others argue for private insurance, for the usual reasons of competition and concern over bureaucracy. And within the private sector, there are arguments for both for-profit and not-for-profit entities. The United States has a mixture of both public and private provision, often in the same narrow sector, with adverse interactions between the two (as witnessed by the literature on crowdout).

Among people who have insurance, economists' greatest concern is not with inadequate coverage but rather with the generosity of coverage for small medical risks. Cost sharing in traditional indemnity insurance policies is relatively low. A typical policy has a deductible of about \$400, with 20 percent coinsurance up to a stop-loss of perhaps \$1,500.<sup>31</sup> For much of the health spending distribution, cost sharing is very slight; this makes moral hazard a significant concern.

A lengthy literature has explored whether this level of cost sharing is optimal or too small.<sup>32</sup> Generally, the literature concludes that current insurance is too generous, leaving people with too little risk for medical expenses, particularly smaller expenses. The most comprehensive analysis

28. Institute of Medicine (2003).

29. On public insurance, see Cutler and Gruber (1996); on uncompensated care, see Rask and Rask (2000); Herring (2001).

30. Woolhandler and Himmelstein (1989).

31. Kaiser Family Foundation and Health Research and Education Trust (2003).

32. See Cutler and Zeckhauser (2000) for a review.

is from Blomqvist, who finds that optimal insurance should have a declining coinsurance rate ranging from 27 percent at \$1,000 of spending (compared to 20 percent in most plans) down to 5 percent at \$30,000 of spending (compared to zero in most plans).<sup>33</sup>

The traditional explanation for the low rate of cost sharing is the tax subsidy to health insurance.<sup>34</sup> As with life insurance, employer payments for health insurance are not taxed as income to workers, while wage and salary payments are. Thus there are incentives for people to run more medical payments through employer-paid health insurance than is optimal. This includes having lower cost sharing than would otherwise be desirable. Empirical work shows that this explanation is important in practice.<sup>35</sup> What other factors contribute to a low rate of cost sharing is not known, however.

Behavioral explanations also merit study. Victor Fuchs argues that cost sharing is low, in part, because, in a stressful time of medical need, people do not want to make decisions about whether additional medical care is worth the money.<sup>36</sup> We argue below that prospect-theoretic preferences for outcomes—for example, loss aversion coupled with risk seeking on losses—make individuals eager to avoid small losses.

These types of “behavioral explanations” make normative analysis difficult. Say that loss aversion affects behavior, implying that even small charges per visit strongly discourage use. Would such copayments represent an effective rationing tool, or would they impose noticeable pain without collecting much revenue? Fortunately for us, our analysis has a descriptive, not a normative, purpose.

Finally, given the strong penetration of health maintenance organizations in the private insurance market and their firm supply-side restrictions, it is hard to assess what cost sharing would be appropriate for their members.

**LONG-TERM HEALTH CARE** Health also has a component of long-term risk. People may have health needs in the future, which they would like to insure today. Most important here are long-term-care expenses.

A large part of the return to long-term-care insurance is related to early mortality among the elderly. Nearly 20 percent of people over age eighty-five are in a nursing home, compared to about 1 percent of the population

33. Blomqvist (1997).

34. Feldstein and Friedman (1977); Pauly (1986).

35. Cutler and Zeckhauser (2000).

36. Private conversation, April 11, 2004.

ages sixty-five to seventy-four.<sup>37</sup> For long-term-care insurance to be effective, people have to purchase it before they reach an advanced age. Yet most elderly do not have such coverage. Only about 10 percent of the elderly possess long-term-care insurance. The bulk of long-term-care expenses are paid for out-of-pocket or by Medicaid.

Risk about future health is related to long-term-care risk. Health insurance for individuals or for groups is usually experience rated. Should health decline, the premium of the individual or the company will increase. Thus one might expect people to purchase insurance against the risk of becoming high cost in the future.<sup>38</sup> In practice, however, we see virtually no insurance against the risk of becoming sick and facing higher annual premiums in the future.<sup>39</sup>

Adverse selection and moral hazard no doubt contribute to the failure of this market, but we believe the theoretical elegance of those subjects has led economists to give them too much weight. Risk aversion certainly differs across people, and that is not so correlated with health status (many individuals who are in good health but are worried about their future health status want to purchase insurance in addition to those who are currently sick). Ex ante moral hazard is also somewhat deterred because declines in health, even if treated, lead to much worse states, for which compensating payments are not forthcoming.

Attention instead focuses on two alternatives. The first is crowdout of private long-term-care insurance by the public sector. The Medicaid program covers long-term-care expenses for people with no private insurance who have exhausted their income and assets paying for long-term-care services. People may thus rely on Medicaid, if it comes to that, or give away assets to qualify for Medicaid, rather than purchase private insurance.<sup>40</sup> Recent simulation work suggests that these factors explain a significant fraction of the lack of purchase of private nursing home insurance.<sup>41</sup> As

37. National Center for Health Statistics (2003).

38. Pauly, Kunreuther, and Hirth (1995); Cochrane (1995); Cutler (1996).

39. There is some informal insurance for this risk, but it is imperfect. Many large employers, for example, prohibit insurers from experience rating at the individual level, providing a form of intertemporal insurance *if* one stays with the same company. Most states prohibit some forms of experience rating for small groups of people, but these prohibitions are often very limited (see Cutler 2002 for a review). Overall, insurance against the risk of becoming high cost in the future is very limited.

40. Pauly (1990).

41. Brown and Finkelstein (2003).

with short-term health insurance, public and private insurance interact inefficiently.

The second explanation for low insurance coverage is that these risks are nondiversifiable and thus shunned by insurance companies.<sup>42</sup> The dominant driver of changes in long-term-care costs over time is technology that allows people to live longer or higher-quality lives, but at high cost. This technology is common across people and thus cannot be diversified cross-sectionally. We explore how this might affect the supply of long-term insurance below.

**SUMMARY** We rate coverage of short-term health risks as fair and coverage of long-term risks as poor. Short-term risks are covered for most people, but, as with mortality risk, there is both underprotection (those without coverage) and overprotection (too generous insurance in indemnity policies). Coverage for long-term health risks is poor, since private insurance is rare and the public sector has substantial inefficiencies.

### *Property*

The third major type of individual risk is damage to personal physical assets. People insure their home, car, and consumer durables against various types of damages. In at least the first two cases, essentially everyone has coverage. Mortgage lenders generally require homeowners insurance, and all states require auto insurance. Fewer people have coverage for consumer durables, but the costs of these goods are far smaller; hence insurance is far less valuable.

The major issue in property insurance is the degree of cost sharing. Most people have relatively low deductibles for home and auto damage. The question is whether these deductibles are too low from the standpoint of the individual and from the standpoint of efficiency. (Efficiency requires avoiding minor claims where administrative costs are large relative to any loss or payment.) There is speculation about this in the literature, but no formal analysis of which we are aware.

As with any evaluation dependent on the parameters of the utility function, we cannot say for certain whether consumers should or should not purchase more generous coverage. But we can evaluate what types of preferences are required to justify current purchases. Suppose that the probability of a loss is  $p$ . The loss may be damage to a car or house. For

42. Cutler (1996).

the simple algebra here, we assume that the loss probability is independent of the details of the insurance policy.<sup>43</sup>

People face a menu of insurance deductibles and premiums, where plans with lower deductibles command higher premiums (more is covered and moral hazard is exacerbated). Denoting the insurance premium as  $\pi$  and the deductible as  $d$ , the period utility that an individual receives from choosing an insurance policy is:<sup>44</sup>

$$(1) \quad V = p U(Y - \pi - d) + (1 - p) U(Y - \pi),$$

where  $Y$  is income, assumed to be constant.<sup>45</sup>

With the specification of a utility function, we can evaluate which of several possible insurance policies would maximize utility. Considering the calculation another way, we can evaluate what risk aversion parameter would be required to explain the decisions that people make. We suppose that individuals have constant relative risk aversion utility:

$$(2) \quad U(C) = \frac{C^{1-\beta}}{1-\beta},$$

where  $\beta$  is the coefficient of relative risk aversion.

There are no national data sets of insurance premiums and coverage choices. To learn about these issues, we have determined the menu of deductibles and premiums that an individual faces by examining the policies offered by some of the largest home and auto insurance companies. Table 4 shows auto insurance policies in two cities (Boston and Miami) and homeowners insurance policies in two others (Philadelphia and Orlando). The most common policy for both risks, chosen by an estimated 60 to 90 percent of people, has a \$500 deductible.

If the deductible is raised to \$1,000, the premium savings range from \$91 to \$264 for auto insurance and \$220 to \$270 for homeowners insurance. This is a significant share of the extra deductible: 18–53 percent for

43. Allowing for moral hazard would only strengthen the conclusions, as the high-deductible policy would look even more attractive.

44. We assume that the utility of money is the same with or without a loss. This seems appropriate in the case of property damage, where the individual is less likely to be permanently harmed.

45. This model assumes no savings. That is empirically close to correct; most people have little savings outside of a house and consume relatively close to their income. We discount borrowing on the house for these purposes. Our simulations assume after-tax income of \$20,000.

**Table 4. Auto and Homeowners Insurance Policies**

U.S. dollars

<i>Type of policy and deductible</i>	<i>Policy 1</i>		<i>Policy 2</i>	
	<i>Premium</i>	<i>Cost relative to common policy</i>	<i>Premium</i>	<i>Cost relative to common policy</i>
<i>Auto<sup>a</sup></i>				
300	1,487	72	829	47
500 <sup>b</sup>	1,415	0	762	0
1,000	1,151	-264	671	-91
2,000	1,064	-351	643	-119
<i>House<sup>c</sup></i>				
250	3,630	130	n.a.	n.a.
500 <sup>b</sup>	3,500	0	1,670	0
1,000	3,230	-270	1,450	-220
1,500	3,100	-400	n.a.	n.a.

n.a. Not available.

a. For auto insurance, policy 1 is offered by Liberty Mutual Insurance in Boston, Massachusetts, and policy 2 is offered by State Farm Insurance in Miami, Florida. In each case, the policy is for a thirty-five-year-old male driving a 2004 Toyota Camry with a clean driving record, good credit, living less than ten miles from work, and with coverage of \$25,000 per person / \$50,000 per accident and \$20,000 per person / \$40,000 per accident involving an uninsured motorist. The coverage under policy 2 is the same, with the exception that the lowest deductible is \$250, not \$300, and the limits for uninsured motorist coverage are \$10,000 / \$20,000.

b. The most common policy, with an estimated market share of 60 to 95 percent.

c. For homeowners insurance, policy 1 is for a \$500,000 home in Philadelphia, Pennsylvania, built of brick structure within five miles of a fire station and 500 feet of a fire hydrant, and with personal property reimbursement included. Policy 2 is for a \$300,000 home in Orlando, Florida, built in 1990 of stone structure within five miles of a fire station and 500 feet of a fire hydrant, with a 2 percent hurricane deductible, and with personal property reimbursement included. Both quotations are from AllState.

auto insurance and 44–54 percent for homeowners insurance. Empirically, the probability of an accident is far smaller than this.<sup>46</sup> For auto insurance, the accident rate is estimated to be 4.1 percent and for homeowners insurance the rate is estimated to be 9.3 percent.<sup>47</sup> A risk-neutral individual would thus buy the high-deductible policy over the low-deductible policy.

With risk aversion, it is possible that people will find the lower deductible optimal. But the levels of risk aversion needed are not plausible. In each of the four cases (two cities for auto insurance and two for homeowners insurance), the required  $\beta$  to rationalize the purchase of the low-deductible policy is more than 10. To put this in perspective, econo-

46. The more precise measure is the proportion of people who file a claim. Small damages may not be reported to the insurance company, but this would be true under less generous insurance as well.

47. On auto insurance, see Insurance Research Council (2002); on homeowners insurance, see Insurance Information Institute (2003).

mists are used to working with models of log utility ( $\beta = 1$ ) or perhaps with a somewhat higher  $\beta = 2$ , but nowhere near  $\beta = 10$ .<sup>48</sup>

**CARVEOUTS** Homeowners insurance does not cover all of the property risks that a typical homeowner faces. Two particular risks are generally excluded: damage from floods and damage from earthquakes. At one time, coverage for floods was included in homeowners insurance. In the 1960s, however, increasing claims from floods, coupled with federal government subsidies to areas affected by floods, led private insurers to pull out of the market.<sup>49</sup> This is the first example of a regular problem: when beliefs about the extent of risk increase and demand for insurance correspondingly rises, insurers often pull out of the market. Today, flood insurance is provided with substantial federal ex ante subsidies and often with ex post federal subsidies (for example, when disaster areas receive assistance).<sup>50</sup>

**THE CONSUMER DURABLES INSURANCE PUZZLE** Bizarre levels of excessive insurance are found most acutely with consumer durables. Table 5 shows the menu of warranties a typical consumer faces when purchasing consumer durables. For a number of electronic items, we present the typical manufacturer's warranty, the extra protection offered to consumers, the cost of that extra protection, and the estimated share of customers who purchase that protection.

At face value, the purchase of this insurance seems hard to justify. A typical electronic item has a probability of needing repairs of about 10 to 25 percent (10 percent for a compact disk player; 25 percent for a camcorder or videocassette recorder). The cost of a repair is perhaps \$100. Thus the expected value of the warranty is perhaps \$15. Since most problems show up very quickly, and are thus covered by the manufacturer's standard warranty, or after many years, after the additional warranty has run out, the actuarial value of these additional warranties is even lower. A guess is \$5 to \$10. The premium for the insurance, in contrast, is many times that amount, generally averaging \$70 to \$100.<sup>51</sup> Indeed, even this calculation overstates the value of the warranty for many insured items, since

48. As a more intuitive reference, a person with a coefficient of relative risk aversion of 10 would not take a gamble over a \$1,000 gain or loss unless the odds of winning were nearly two-thirds.

49. U.S. General Accounting Office (2003).

50. Adverse selection is a serious challenge to flood insurance as it is currently written. In theory, if the market were purely private, insurers would develop methods to better discriminate and price flood risk.

51. This is roughly the equivalent of the plans priced as a share of purchase cost as well.

**Table 5. Common Insurance for Consumer Durables**

<i>Product</i>	<i>Typical warranty</i>	<i>Extended product protection or replacement plans<sup>a</sup></i>	<i>Percentage of customers who purchase<sup>b</sup></i>	<i>Frequency of repairs<sup>c</sup></i>	<i>Typical repair cost<sup>c</sup></i>
Camcorders	One year for parts and labor	Extended product protection at \$70 for two years, \$120 for three years, \$300 for five years	30	25 percent within five years, 8 percent within three years	\$125
Videocassette recorders	One year for parts; ninety days for labor	Product replacement plan at 15 percent of cost for two years	70	24 percent within five years	\$75
DVD players (single)	One year for parts and labor	Product replacement plan at 15 percent of cost for two years	50	n.a.	\$100
DVD players (home theater systems)	One year for parts	Extended product protection at \$30 and labor for two years, \$175 for five years	50	n.a.	n.a.
Compact disk players	One year for parts; ninety days for labor	Product replacement plan at 15 percent of cost for two years	80	10 percent within five years	\$80
MP3 players	Ninety days for parts and labor	Product replacement plan at 15 percent of cost for two years	70	n.a.	\$100
Television sets (item cost \$80-\$180)	Two years for picture tube; one year for parts; ninety days for labor	Product replacement plan at 15 percent of cost for two years	30	7 percent during lifetime	\$90
Television sets (item cost \$180+)	Two years for picture tube; one year for parts; ninety days for labor	Extended product protection depending on cost of the item, in the range of between \$150 for three years and \$2,000 for five years	45	20 percent during lifetime	\$175
Boom boxes	One year for labor; ninety days for parts	Product replacement plan at 15 percent of cost for two years	60	n.a.	n.a.

Microwaves	One year for parts and labor; ten years for magnetron	Extended product protection at \$70 for three years, \$100 for five years	5	n.a.	\$150
Dishwashers	One year for parts and labor	Extended product protection at \$90 for three years, \$140 for five years	35	19 percent within five years, 8 percent within three years	\$250 (major); \$95 (minor)
Washers	One year for parts and labor; five years for transmission	Extended product protection at \$100 for three years, \$170 for five years	20	23 percent within five years	\$300 (major); \$100 (minor)
Dryers	One year for parts and labor	Extended product protection at \$70 for three years, \$140 for five years	20	14 percent within five years	\$150 (major); \$80 (minor)
Refrigerators	One year for parts and labor; five years for compressor	Extended product protection at \$110 for three years, \$170 for five years	30	8 percent within three years	\$300
Vacuums	One year for parts and labor	Extended product protection at \$40 for two years, \$70 for five years	40	34 percent within five years	\$50
Electric ranges	One year for parts and labor	Extended product protection at \$90 for three years, \$140 for five years	30	14 percent within five years, 8 percent within three years	\$300 (major); \$100 (minor)
Digital cameras	One year for parts; ninety days for labor	n.a.	n.a.	n.a.	n.a.
Treadmills	One year for parts; two years for labor; three years for motor	Extended product protection \$140 for three years	10	n.a.	n.a.
Laptops	One year limited warranty	Extended product protection \$190 for two years, \$280 for five years	n.a.	19 percent within five years	\$100

n.a., Not available.  
a. Common plans offered at Sears and other retailers.  
b. Estimates from sales clerks at Sears in Boston, Mass.  
c. Information from [consumerreports.org](http://consumerreports.org) and sales clerks in Boston, Mass.

the prices of electronic goods are falling rapidly—over 20 percent a year in many cases—and their capabilities are increasing. Hence, the net benefit of repairing an item when it breaks, as opposed to merely replacing it, is falling substantially over time.

Despite this fact, purchase of comprehensive protection for consumer durables is widespread. An estimated 20 to 80 percent of people purchase extended protection for consumer durables, and such protection is widely perceived as lucrative.<sup>52</sup>

**SUMMARY** The major types of property insurance are widespread, being mandated by government (auto insurance) or required by lenders as collateral (homeowners insurance). Underpurchase is generally not a problem in this market. But overinsurance is. Many people have deductibles that seem far too low given price differentials, the size of the risk, and common beliefs about the extent of risk aversion in normal circumstances. For this reason, we rate coverage of home and auto insurance as fair. The magnitude of consumer durable insurance is more problematic, since almost no utility function would justify purchase of insurance for low-cost durables. We assess the function of this market as poor.

### **Insurance in Practice: Business Risks**

Some markets for business risks seem to work well. Businesses own physical property, for example, and most businesses insure at least some portion of that property. The data on the extent of this insurance are poor, but studies of the industry suggest that this insurance is generally believed to work well. This is not surprising, since large businesses have individuals who specialize in the purchase of insurance, and even small businesses usually have some financial expertise. Based predominantly on secondary references, we rate this insurance as good on our scale.

Businesses also have general liabilities associated with damages they may incur in the course of doing business (for example, suits arising from injury to a customer falling in a store or to a patient suffering from a misdiagnosis or a failed operation). The performance of this insurance varies by industry. If we take account of both drama and policy import, the situation is particularly problematic in medical malpractice. There have been three medical malpractice crises in the past twenty-five years: one in the

52. Consumer Reports (1998).

mid-1970s, another in the mid-1980s, and a third in just the past two years.<sup>53</sup> Each crisis occurred when the claims paid increased more rapidly than the premiums collected, precipitated by changes in the social climate, not any upswing in adverse medical incidents. The number of lawsuits filed increased more rapidly than expected, and the awards of liability judgments were greater than expected.

As a result, insurers lost money. In response, premiums rose precipitously, many insurers dropped out of the market, many physicians found insurance difficult to obtain, and some physicians changed their practices (for example, some obstetrician-gynecologists quit doing obstetrics). After only a few years, the market returned to reasonable function, with insurance again available, albeit at higher price. This type of availability crisis, though often without a return to normalcy, is common with many types of business insurance.

#### *Risks with Residual Variability: Environment and Terrorism*

In theory, insurance is best equipped to deal with small- to moderate-probability, high-loss risks, where it does the most good. However, it is for precisely those risks that business insurance has failed most recently. Environmental liability is the classic issue here, recently joined by terrorism losses.<sup>54</sup> In each case, private markets worked much less well than anticipated, once the risks eventuated. We discuss these two risks in turn.

Prior to the mid-1980s, insurance provided firms with environmental coverage indefinitely for events that occurred during the policy year (termed an occurrence-based policy). Long-term risk was thought to be small. Events in the 1970s and 1980s, however, highlighted the “long-tailed” nature of risk. Asbestos claims in the 1970s, for example, dealt with exposure to asbestos in the 1940s and 1950s. Total costs of land-based pollution control—predominantly remediation efforts under the Resource Conservation and Recovery Act and Superfund—went from \$10 billion to \$57 billion (1992 dollars) from 1972 to 2000.<sup>55</sup>

Exacerbating this vast escalation in unanticipated costs was the perception that legal interpretations were changing the provisions of insurance policies. It was frequently asserted that courts ignored restrictions in poli-

53. Mello, Studdert, and Brennan (2003).

54. On environmental liability, see U.S. General Accounting Office (1986, 1988); Huber (1988); Zagaski (1992).

55. U.S. Environmental Protection Agency (1990, pp. 8–21).

cies to “sudden and accidental” environmental damage. Moreover, the courts, usually on the basis of jury decisions, imposed liabilities well beyond those the policy was intended to cover.<sup>56</sup> The result was increased uncertainty about the liability of environmental insurers.

In theory, an increase in risk should increase the demand for insurance, increase the price of insurance, and result in greater overall coverage at higher prices. This was not the outcome with environmental risk, however, or with medical malpractice insurance. Rather, the policies themselves changed in a way that made them *less* generous. For example, the occurrence-based policy was dropped in favor of a claims-made policy, which covers damages only if the claim is filed within a certain period of time.<sup>57</sup> Effectively, this eliminates insurance coverage for long-tailed risk, placing that risk instead on the insuring firm, in the form of higher premiums as the extent of damages is realized. Indeed, the reduction in insurance coverage was not limited to primary insurance markets. In 1984 international reinsurance markets began denying coverage for pollution liability reinsurance.

Insurers also imposed aggregate dollar limits on payouts for environmental damage, to limit their overall risk exposure. Of course, this denies protection precisely where it is needed most: for high losses.<sup>58</sup> These changes limited the aggregate risk born by the insurer, with the consequence that more of the risk was retained by the firms at risk. Even two decades after the liability revolution and the initial cutbacks in insurance coverage, the market for environment insurance is substantially less generous than it was.<sup>59</sup>

The “crisis” in terrorism insurance burst onto the scene on September 11, 2001. The attacks that day drastically changed expectations about the likelihood and magnitude of terrorism losses in the future. Unlike nature’s

56. A notorious case of jury overreach in damages—not related to the environment—involved a new car that BMW sold without notifying the buyer that it had been repainted after being damaged in shipping. The buyer was awarded \$4,000 in compensatory damages and \$4 million in punitive damages.

57. Similar changes happened in medical malpractice insurance in the 1970s and professional liability insurance in the 1980s. The stated reasons for the change were similar to those for environmental coverage.

58. There may be a moral hazard justification for limiting coverage for large losses. Insured individuals may have some control over the size of loss, trading off probability and magnitude. Thus a toxic waste release on the ground may be allowed to sit untreated, avoiding a medium loss, but risking a much larger loss should it leach into the groundwater.

59. An implicit part of the coverage for many types of insurance was lost—namely the idea that if you insure today, you will be guaranteed coverage tomorrow.

extreme blows (for example, Hurricane Andrew), which can increase perceived future losses by, say, 100 percent, the man-made loss of September 11 increased future expected terror losses at least by a factor of ten, perhaps much more. The immediate result was a crisis in insurance availability. Insurers claimed that terrorism was “uninsurable” and stopped writing coverage for it. About one-quarter of policies written in 2002—and an even larger share for large firms—excluded terrorist acts.

Although the most dire predictions about the consequences of lost insurance did not come true—buildings got built and buildings traded hands—the potential for severe economic disruption was judged to be high. After several months, the federal government stepped in to stabilize the market. The Terrorism Risk Insurance Act of November 2002 provides coverage related to international terrorism, with the federal contribution rising with the magnitude of loss up through \$100 billion of insured losses. Beyond that, the Congress decides what additional payments it wants to make.<sup>60</sup> In exchange for taking the back-end risk (without coinsurance), the act requires insurers to write coverage for smaller terrorist losses. The act sunsets at the end of 2005, and it is not clear what will happen in the market beyond that point.

#### *Employment Practice Insurance*

Many businesses also have insurance for employment liability resulting from claims such as sexual harassment and race or gender discrimination lawsuits. As the potential liability from employment issues has become more widespread, the cost of this insurance has increased. As table 6 shows, a business with twenty full-time employees and twenty part-time employees, for example, would pay a premium of \$5,000 a year and have a 10 percent coinsurance rate.<sup>61</sup> There is also a limit on *insurer* liability, generally \$1 million. We do not know of general assessments of this line of insurance, however, so we omit it from the table.

60. Thus businesses are protected against attacks that knock things down, which are highly unlikely to exceed the losses of September 11. However, they are not protected against other risks such as dirty bombs, which make major parts of a city uninhabitable for a sustained period.

61. As with auto insurance, the change in premiums for a change in deductible is highly nonlinear. Moving from a \$5,000 deductible to a \$2,500 deductible raises the premium by only \$26. Raising the deductible to \$10,000, in contrast, lowers the premium by more than \$1,000. We suspect that adverse selection and some miscalculations by the insurance company are behind these rate differences.

**Table 6. Premium for Employment Practices Liability Insurance<sup>a</sup>**

U.S. dollars

<i>Deductible</i>	<i>Premium</i>	<i>Difference</i>
2,500	5,357	0
10,000	4,283	-1,074
25,000	4,021	-1,336

Source: Farmers Insurance Group.

a. The premium is for a policy in Massachusetts with a \$1 million limit, cap of \$50,000, and coinsurance of 10 percent. The firm has twenty full-time and twenty part-time employees.

*Pension Obligations*

Obligations to retirees represent an important long-term risk to firms. Many firms, particularly large manufacturers, have substantial defined-benefit pension obligations. Firms also have obligations for retiree health insurance. These obligations are risky because retirement experiences and the earnings on pension assets are both uncertain.

Insurance for these risks is affected by a substantial degree of moral hazard. Firms that are doing poorly have the option of declaring bankruptcy and defaulting on their pension liabilities rather than continuing to pay them. As a result of this moral hazard, pension risk is insured by the government. The Pension Benefit Guarantee Corporation (PBGC) requires firms to contribute an annual premium based partly on the number of retirees and partly on the degree of pension underfunding.

Like many government programs, PBGC has difficulty changing prices to guarantee solvency. This is particularly difficult since pension default is a long-tailed risk: premiums taken in today need to be saved for potentially high use in the future. Boyce and Ippolito estimate that PBGC charges premiums that are 50 percent below what equivalent private insurance companies would charge, with unfunded liabilities currently more than \$100 billion.<sup>62</sup> For these reasons, the General Accounting Office rates PBGC as high risk.

Because participation in PBGC is mandatory, we lose the yardstick of what private insurance would charge for equivalent coverage. And because it is effectively subsidized, there is little complaint. For these reasons, we rate the operation of pension insurance as poor.

62. Boyce and Ippolito (2002).

*Summary*

Businesses are much more sophisticated than individuals about the purchase of insurance, with professionals handling the task in large firms. For traditional risks, insurance works well. Recent years, however, have witnessed the rise of risks due to purposeful human activity—for example, the liability revolution or terrorism. These risks are larger than older risks, are correlated across insuring firms, and often are not resolved for many years. For such risks, insurance markets tend to work poorly.

**Explanations for Poor Performance**

Insurance in practice differs substantially from insurance in theory. Despite rating many insurance markets as likely to work well in theory, only one of the actual markets we evaluate draws a “good” rating—homeowners insurance. Four markets get a fair rating (life insurance, short-term health insurance, auto insurance, and general business property and casualty insurance). The remaining six risks (annuities, long-term health risks, consumer durables insurance, and business environmental, terrorism, and pension coverage) all rate poorly. While some may quibble with our ratings in particular cases, we suspect that none would disagree with our overall assessment of substantial underperformance in actual insurance markets.

The discrepancy between theory and practice is of two types. The first is a mismatch between expected coverage and actual coverage. Some risks that we expect to be covered, such as terrorism risk, long-term health risk, longevity risk, or environmental liability risk, are covered not at all or, at best, are covered poorly. Even risks that are covered well, such as life insurance, are not covered by everyone who likely would benefit from such insurance. In contrast, many risks that theory predicts would be uncovered, such as small losses for automobiles, houses, and consumer durables, are covered by individuals who voluntarily purchase insurance. Assuming rational decision, only excessively high degrees of risk aversion could explain the pattern of property coverage that we observe. Further, many elderly seem overinsured against unexpected death (life insurance), even as they are underinsured against beyond-average survival (annuitization).

In addition, there is little rhyme or reason to the mix between public and private coverage. To be sure, coverage of many of the largest risks, such

as terrorism, has made its way into the public sector, as one might expect. But smaller risks are covered publicly as well (flood insurance, for example), and many large risks are left to private insurers (environmental damage).

A common but troubling phenomenon is severe underpricing of risk coverage by the public sector, often because premiums are insufficiently responsive to risk differentials. Savings and loan insurance prior to the multi-hundred billion dollar bailout is a good example. When politics and political pressures intrude, it is often impossible to impose significant differential rates for insurance. Often government just sets a risk standard to be met if one wants to insure. Such standards are often ambiguous, and government denial of insurance is often too much of a nuclear weapon.<sup>63</sup> The interactions between public and private insurance seem unhelpful at best and harmful at worst.<sup>64</sup>

There are a number of complementary explanations for the mismatch between insurance theory and insurance markets in practice. We explore them in the next sections.

#### *Information-Based Explanations*

The explanation favored by most economists (casual polls suggest) is asymmetric information. Insurers may not offer particular products because they worry that the product will affect the behavior of the insured (moral hazard) or will be selected by people who have a high likelihood of suffering a loss (adverse selection). Such “bad behavior” cannot be monitored.

These explanations contribute, but we suspect that they are far from sufficient. For many of the risks that are uncovered, such as long-term

63. The 2003 struggle of the Pension Benefit Guarantee Corporation with U.S. Airways is instructive. To enable it to emerge from bankruptcy, U.S. Air argued that it needed to lower its pension obligations substantially. Failing to secure direct legislative relief, U.S. Air terminated its pension plan for pilots. On April 1, PBGC became responsible for this plan. In its last filing prior to termination, U.S. Air reported that the fund was 94 percent funded on a current liability basis. At termination, however, it was only 33 percent funded. This case highlights two problems: many insured companies are underfunding their pension plans, and companies may be able to use Chapter 11 to separate their assets from their pension obligations and put the burden of pensions on PBGC.

64. On pricing, the “sliver solution” deserves attention. With it, a private insurer writes coverage for a small part of a risk. The government insures the rest at a premium proportional to the private insurance. This inserts private market discipline into the price. Government terrorism reinsurance does this to some extent, charging insurance companies roughly 10 percent of their premium.

environmental exposure by firms or the need for long-term care, evidence of moral hazard is at best tenuous. Where we are certain that there is moral hazard is insurance for use at a point in time, such as for short-term health care. This risk is covered, if anything, too well.

Neither is adverse selection much of an explanation. Evidence to date suggests no adverse selection in the purchase of long-term-care insurance, for example.<sup>65</sup> While adverse selection has dominated the theoretical literature, the actual experience of an insurer—what we think of as “adverse experience”—depends on many factors beyond perceived risk. Risk aversion is important: healthy individuals who are worried about their health purchase insurance just as much as high-risk individuals. As a side benefit, this keeps premiums low for those on the margin of purchase.<sup>66</sup> Indeed, risk aversion may be inversely correlated with risk levels, if risk-averse people take better care to avoid putting themselves in risky situations.

Ignorance is also a blessing here. If potential purchasers of insurance do not know their risk levels, there will be no correlation between risk and the insurance decision. More generally, nonrational behavior helps to deter adverse selection. It introduces many new elements that encourage people to insure, without necessarily being correlated with risk.<sup>67</sup>

In many situations, we might expect that insurers would know *more* about risks than individuals. This is likely the case with warranties for consumer durables and possibly with health insurance as well. Variation in price by risk status limits adverse selection, although it may be inefficient in other ways (preventing people from insuring their risk level).

The limited explanatory power of asymmetric information-based explanations shows up most clearly in the analysis of terrorism insurance. By all assessments, there is little to no differential information about the likelihood of terrorists striking any particular object (adverse selection); neither is it plausible that firms would substantially lower their guard against terrorist attack (moral hazard) just because they are insured. (The uncompensable losses, including one’s own loss of life, are just too great.) Insurance coverage has dried up for other reasons.

65. Finkelstein and McGarry (2003).

66. Market power on the part of insurers cuts in the opposite direction. Prices above marginal cost encourage low-risk people to drop out of the market.

67. From the welfare perspective, the variation introduced by behavioral decision, unlike that generated by varying levels of risk aversion, does not assure that those who do buy insurance are the ones who need it most.

Our more general hypothesis is that, in many markets where adverse selection can be expected to exert a powerful undertow on the market, adverse selection proves to be a mild current rather than a sweeping tide. We propose three alternative reasons why the theory and practice of insurance diverge in the early twenty-first century.

*Incomplete Diversification, Supply-Side Contracting Difficulties*

The first explanation is insufficient diversification of insurance companies. People may want insurance against a risk, but insurers have to be willing to provide that risk, even at rates far above the best estimates of actuarial cost. If insurers—or, more accurately, insurance executives—are worried about their capitalization, they may be unwilling to write policies for some risks, even if both price and demand are high. The prospect of severe losses, or even bankruptcy with its limited liability, may not scare the diversified investors in an insurance company, who would be happy to write unusual insurance for robust premiums. But insurance executives have to worry about misestimating risks and premiums, with consequent collapse of their career.<sup>68</sup>

In the standard theory of insurance, risks are minimally correlated across the insured. A few people will experience a loss in a period, but the vast majority will not. Insurers use the premiums from those who do not suffer a loss to compensate those who do. Many risks, however, have an aggregate component; many people incur a loss at the same time. Nuclear wars represented the ultimate aggregate risk for many years. Today's aggregate risks include new liability revolutions (as with environmental damage), significant increases in prices (say, for medical care), and major terrorist attacks. Even good developments have a component of aggregate risk. Thus rapid rises in longevity would impose heavy aggregate costs on pensions and other annuities. Long-term-care insurance well represents an aggregate risk. When the expected costs increase for one person—say, because a jump in longevity makes nursing home stays, particularly Alzheimer's stays, more expensive—this factor applies to many individuals with insurance. As a result, the traditional method of risk diversification—pooling independent risks across people—fails.

68. The behavior of Warren Buffett, by contrast, shows what happens when an executive has no such concerns.

Risk-neutral insurers do not care about this aggregate risk. The owners of insurance company assets can diversify the risk posed by diversifying their portfolio. But managers and workers in those insurance companies may care. They may lose their job if the company goes bankrupt or if that line of business loses gobs of money. This leads to a classical principal-agent problem. Thus the insurance company itself, under guidance from its executives, may behave in a risk-averse manner.

Ambiguous risks—that is, those whose losses are hard to estimate—aggravate any principal-agent problem. Think of terrorist risks today. Were an insurance company to write substantial coverage, and should there be unexpectedly large and frequent attacks, Monday morning quarterbacks would be likely to demand the head of those who decided to write the coverage. Thus principal-agent problems strongly discourage the sale of insurance for ambiguous risks.

A moderately risk-averse insurance company will still sell insurance but will impose a higher administrative charge to do so. Administrative loads in long-term-care insurance, which has a large contingent of aggregate risk, are 35 percent at a minimum and reach 50 to 70 percent for some groups.<sup>69</sup> In comparison, administrative costs in short-term health insurance are only about 15 percent, roughly their level for annuities.<sup>70</sup>

An insurer who is more risk averse than the potential insured will refuse to write insurance altogether. We often see this in the nature of risk exposure that is written. When they do write policies, long-term-care insurers limit their exposure to a fixed dollar amount per day of nursing home care; one cannot buy coverage for the actual cost of care received (in contrast to annual health insurance). Similarly, environmental insurers and medical malpractice insurers refuse to cover all claims that result from operations today; instead, they put a time limit on when the claim must be filed.

The cycle of insurance crises shows clearly this problem. When risks increase more than expected—for example, the liability revolution, knowledge of particular chemical harms, terrorist action—insurers respond at first by refusing to cover new risk. That is understandable, as markets digest the new information. Over time, prices rise. That too is predictable. But even after the market “settles down,” insurance frequently becomes

69. Cutler (1996); Brown and Finkelstein (2003).

70. U.S. Department of Health and Human Services, Health Care Financing Administration (1984); Mitchell and others (1999).

less generous than it was formerly and stays that way indefinitely. That is the economically undesirable part.

While the practice may appear to be irrational economically, the idea of severely curtailing company risk is standard advice in the insurance industry. According to a leading analyst of the insurance industry, insurers should keep the risk of any line of business small: "To provide stability and safety, an insurer should limit its maximum loss exposure on a single risk (or group of related risks) to a small percentage of its policyholders' surplus, normally less than 2 percent."<sup>71</sup> With aggregate risks, insurers face the Scylla and Charybdis of not knowing their market or having too heavy exposure. The outcome is that the insurance industry does not write certain classes of risk.

For some risks the government may step in, as it has with high-cost terrorism risk. But that is a short-term (three-year) solution, it is an adjunct to other private sector insurance, and it is in an area where the government could be deemed to have responsibility for controlling the risk. Government as reinsurer is not a likely solution for many troubling aggregate risks, such as long-term environment or health care risks.

Fortunately, a far greater pool of resources could conceivably absorb such risks: financial markets. Risks that are large even for the world's insurance pool—estimated to be on the order of \$1 trillion in the United States and \$2 trillion worldwide—are small relative to financial markets.<sup>72</sup> For example, the value of equity markets in the United States alone is more than \$10 trillion. One great advantage of financial markets as insurance instruments, apart from their volume, is that they effectively bring together tens of millions of investors, none of whom would have to hold much of an aggregate risk.

There has been recent use of financial markets to diversify aggregate insurance risks. Most prominent have been catastrophe bonds, used to reinsure weather-related housing risks. Interest in these bonds rose with Hurricane Andrew in 1992, the Northridge earthquake in 1994, and the Kobe earthquake in Japan in 1995, all involving losses that were massive relative to historical experience. The market for catastrophe bonds is relatively small, but it is perceived to be successful.<sup>73</sup> One measure of success is the prices charged. Famed investor Warren Buffett underwrote earth-

71. A. M. Best (1991, p. xiii).

72. Insurance Information Institute (2003).

73. U.S. General Accounting Office (2002).

quake reinsurance in California for four years in the early 1990s, earning an 11 percent premium for an estimated 1 percent risk. Buffett recognized what other insurers must have missed: this risk, though unusual, brought neither adverse selection nor moral hazard. Over time, the advantage of this investment became known and premiums fell. “The influx of ‘investor’ money into catastrophe bonds—which may well live up to their name—has caused super-cat prices to deteriorate materially. Therefore, we will write less business in 1998,” Buffett wrote.<sup>74</sup>

Use of these new instruments is not without problems. Participation of insurance companies is likely to be important, since these companies have vital expertise in assessing risk. Possibly, insurance companies will underwrite the risks initially, to provide their assessment expertise for a fee, and investors will then take their share. Reinsurance is already common in the insurance industry, although it is typically done by specialized companies rather than broader financial markets.

Perhaps more important, the nature of the payment needs to be determined. Investment managers are currently paid for assuming risk. The common arrangement with hedge funds, for example, is for the general partner to charge an annual management fee (say, 1 percent) and to receive 20 percent of the profits or excess profits.

With insurance, equivalent arrangements would be hard to structure, since risks are discrete and it is hard to know whether a policy issued has been profitable in expectation thus far. If there is a 3 percent chance of a calamitous event, for example, but otherwise no losses, a general partner paid on the basis of annual “profits” would be expected to do quite well for a period before the odds bring down the house. Further compounding the difficulty, prior management and incentive fees would probably be unrecoverable in the event of a bad loss. Many of the names at Lloyds of London experienced just such a string—many moderate successes followed by a mammoth loss—when the liability revolution hit.

One way around this problem is to have a highly diversified portfolio of risks. But such diversification blunts the value of specialized expertise on the market being insured. Other types of contracts may be needed.

With additional time, we expect that financial instruments will continue to evolve and allow further investors to enter the market. It is possible—perhaps likely—that the first problem we identify has a solution forthcoming.

74. Wettlaufer (1998).

*Nonstandard Behavior on the Demand Side*

The second reason why theory and practice diverge in the insurance industry is that the potential purchasers of insurance engage in nonstandard economic behavior. In traditional decision theory, people have concave utility functions defined over consumption. Risk-averse people will want to insure against all risks, assuming fair actuarial pricing. They temper this because of moral hazard and administrative costs, which lead prices to exceed expected payouts. In response, people choose to cover large risks, at least substantially, and leave small risks unprotected.

Such preferences may not correspond to reality, however, as the prevalence of insurance coverage for small risks suggests. Several alternatives to standard preferences may explain this type of coverage.

**PROSPECT THEORY** A leading possibility is loss aversion: the idea that people significantly dislike any loss, even small ones.<sup>75</sup> Hence, people are willing to pay far above actuarial value to protect against small losses, such as when a stereo breaks.<sup>76</sup>

It seems plausible that this phenomenon could explain some of the anomalous behavior we have documented here, especially the purchase of insurance for small risks. To see how readily this explanation might work, we modify our analysis to allow for simple loss aversion. Suppose that the utility consequence of incurring any deductible is  $1 + \theta$ , where  $\theta$  represents the additional utility cost of having to make a cash outlay. With this set of preferences, expected utility is given by:

$$(3) \quad V = p U[Y - \pi - d * (1 + \theta)] + (1 - p) U(Y - \pi).$$

If we assume a particular utility function, we can use the menu of choices that people face to determine what value of  $\theta$  is required to explain insurance decisions. Assuming that utility is logarithmic in consumption ( $\theta = 1$ ), for automobile insurance the  $\theta$  required to explain a preference for a low deductible over a high deductible ranges from 0.5 to 2.5, depending on the policy and the degree of risk aversion. For homeowners insurance, the equivalent value of  $\theta$  ranges between about 3 and 4. (Such a value would imply that deductibles have a utility-equivalent cost of deductibles of \$3 or \$4 per dollar; this value is too high to seem plausible.) Thus pref-

75. Kahneman and Tversky (1979).

76. Kahneman and Tversky (1979) hypothesize that people were concave in both gains and losses about the certainty point. Additions to wealth were valued with concave utility, as were losses to wealth: small losses had a greater marginal cost than did large losses.

erences of this sort could perhaps contribute to the overinsurance phenomenon, but they cannot explain it all.

**AFFECTIVE FORECASTING** Recent work demonstrates that people significantly overestimate the magnitude of the negative experience from a loss. Gilbert and others, for example, attribute this to a durability bias—a belief that the negative aspects of the loss will last much longer than they do—and to a significant overestimate of the regret they will feel after a loss.<sup>77</sup> People who believe their utility will diminish permanently with a loss will want to purchase more insurance coverage than people who recognize that losses will be readily accommodated. It is not surprising that such people are interested in very generous insurance.

**ANXIETY AND REGRET** Consider a significant loss: one that would drive down utility considerably but would not affect marginal utility of income. For example, one might have a painting of one's departed grandmother, which is worth a great deal sentimentally but little monetarily. The death of a nonearning loved one would be the same. Rationality-loving economists would say not to insure. But many people do.<sup>78</sup> One reason for this is that insurance reduces anxiety, acting as a form of reassurance for many people. If the heirloom gets stolen or damaged, people reason that at least they will receive some money for their pain.<sup>79</sup>

Regret is similar to anxiety, although it looks backward rather than forward. A person who has rationally chosen not to purchase insurance may suffer lower utility if the bad state of nature arises, both because the risk occurred and because the person did not purchase insurance for the risk. Imagine, for example, that a person buys a new camcorder, rationally chooses not to buy supplemental insurance but then finds that the camcorder breaks in the first week of use. The person will regret not having purchased the insurance. Knowing the possibility of regret later on, the person in the store may choose to buy camcorder insurance.

Purchasing insurance as a means to reduce anxiety or stave off regret is not difficult to reconcile with the standard neoclassical framework. We show the situation for anxiety, although regret is similar. Suppose that an individual is faced with a lottery  $L$ , defined by  $L = [-d, p; 0, 1 - p]$ , where

77. Gilbert and others (2002).

78. The American Council of Life Insurers reports that about 15 percent of people under age eighteen have life insurance (Curry 2003). Although such coverage may be for burial costs in some instances, such costs are trivial relative to the cost of raising a child.

79. It may also be that people do not realize that their marginal utility will not change, perhaps because they are not proficient at forecasting their utility in different states of nature.

$d > 0$  is the loss and  $p$  is the probability of loss. An individual determines that her utility for outcomes  $V(L) = V(C)$ , where  $C = [-e, 1]$ ; that is,  $e$  is the certainty equivalent. If insurance is offered at price  $f > e$ , the person will decline, since for lottery  $D = [-f, 1]$ ,  $V(L) = V(C) > V(D)$ .

Now allow for a time dimension to the lottery: for example, the camcorder might break down any time in a three-year period. Utility has two dimensions: the lottery  $L$  and time  $t$  ( $t = 0$  is the present). Unresolved risk creates anxiety. We model this as  $U(L, t) = V(L) - A(L, t)$ . Our interest is in the form of  $A(L, t)$ . First consider the nature of the lottery. If the lottery is over good states ( $d < 0$ ), and  $t > 0$ , there might be “joy along the way”— $A(L, t) < 0$ —and people will not purchase insurance. If, as with insurance situations, the outcome is significantly adverse ( $d > 0$ ), anxiety is likely to arise. If  $L$  involves only a certainty outcome,  $C$ , we normalize to no anxiety.<sup>80</sup> The time dimension is also important. Without significant dispute (we suspect), we assume that  $A(L, 0) = 0$  and  $\partial A/\partial t > 0$ .

Assume that the insurance purchase is for a year and that the lottery is resolved at the end. Our potential insured experiences anxiety. Then we might have:

$$(4) \quad U(L, 0) = V(L) > V(D),$$

but  $U(L, 1) = V(L) - A(L, 1) < U(D, 1) = V(D) - A(D, 1) = V(D)$ . This can happen since  $A(L, 1)$  is positive and  $A(D, 1)$  is 0. Thus the person may reject the insurance if the lottery is resolved immediately but accept it if resolution is delayed sufficiently.

**SALIENCE** Many insurance policies pay double if someone dies in an accident as opposed to natural causes. When asked whether they want to purchase such coverage, many individuals, particularly young individuals, say yes. Insurance theory would say the individual should insure for the same amount, no matter how he dies. (If anything, dying in an accident is likely to be cheaper than, say, dying from cancer.) But the accident becomes salient as a way to die, and individuals purchase such insurance. We suspect a form of “availability heuristic” is playing a role here.<sup>81</sup> We see this in other contexts as well, such as Kunreuther’s finding that people purchase flood insurance after a flood and purchase supplementary insurance before taking an airplane trip.<sup>82</sup>

80. People might get anxious about a bad event they know will occur (a borrowed car must be returned), but we abstract away from this.

81. Tversky and Kahneman (1974).

82. Kunreuther (1978).

**HYPERBOLIC DISCOUNTING** Some insurance that we think should be purchased, such as annuities when elderly, are not bought. One possibility is hyperbolic discounting: people value today more than proportionately over the future. A hyperbolic discounter knows that purchasing an annuity is a good idea but always wants to delay the purchase to the next year—either because consumption is particularly valuable today or because it is easier to delay decisionmaking until tomorrow. Empirically, people who are forced to make financial decisions by a specified date choose to save more than people who are free to make such decisions at any time.<sup>83</sup>

**SUMMARY** Almost certainly, one theory cannot explain all the phenomena we seek to explain. As a starting point for future research, we provide some of our own speculation about theories of likely importance on the consumer side of the market, shown in table 7. Future research is needed to test these theories more completely and possibly to develop others.

We have principally been interested in improving descriptive theory. Usually when economists, including the authors, find normative (or prescriptive) theory and practice diverge, they proselytize for the former.<sup>84</sup> However, studying insurance is a sobering prospect. Unlike our standard models, most insurance decisions involve future contemplation and backward reflection. Thus, for example, given the importance that consumers attach to minimizing regret and anxiety, there is strong argument that such concepts should be given a role in our normative theories. This is a task for future efforts.

### *Probability Monopoly*

There is considerable market power for some forms of insurance. At the high end, only the electronics store can realistically sell you an extended warranty at the time you purchase a camcorder or DVD player. Much life insurance is sold by salesmen calling on buyers rather than vice versa. Even standardized Medigap insurance shows considerable price variability, a sign of market power.

Given market power, the sale of insurance introduces an element of monopoly pricing. People have some idea of expected loss probabilities,

83. Choi and others (2002).

84. Prescriptive theory tells what a particular individual should do to maximize his or her own welfare. Normative theory tells what is desirable for a group of individuals and requires some notion of social welfare.

**Table 7. Examples of and Possible Explanations for Insurance Phenomenon**

<i>Phenomenon</i>	<i>Example</i>	<i>Possible explanation</i>
Insurance against small risks	Appliance insurance, low-deductible insurance	Prospect theory, regret avoidance
Insurance against risks that do not affect marginal utility	Single elderly with life insurance; family heirlooms	Affective forecasting, regret avoidance, anxiety
Insurance against salient risks	Purchase of flood insurance after flood	Salience, anxiety
Lack of insurance for big risks	Underpurchase of annuities, life insurance	Hyperbolic discounting

but this information is not complete.<sup>85</sup> Indeed, the loss probability might be aided by salespeople (once the device has been safely purchased, so as not to imply that its quality is low).<sup>86</sup> Potential insurers can thus price above marginal cost, knowing that those with low risk assessments will choose to forgo coverage, while those with high assessments will buy. The markup on the population with high loss probabilities can make this a profitable strategy. We refer to this situation as probabilistic monopoly and believe that it helps to explain the purchase of vastly overpriced insurance in a range of situations.

Consider a specific example: a store faces risk-neutral consumers with different probabilities of needing repairs. The likelihood distribution is triangular, with density of  $8-32y$  for probability  $y$  ranging between 0 and 25 percent. The implied mean breakdown probability is 8.33 percent. The store knows that the true likelihood is 2 percent, the same for all customers.

The store will set a price of insurance that maximizes expected profits, knowing the distribution of perceived risks. Normalizing the price of the good to 1, the solution is the value  $x$  that maximizes

85. Unlike the situation with adverse selection, it is possible that people have differences in their perceived loss probabilities that are not true in reality. A person might think he is clumsy with electronic devices but not know that the devices are designed with clumsy people in mind.

86. High-priced extended warranties undermine a product's presumed reliability. Thus we now have many auto companies offering extremely long warranties. Electronics stores only offer extended warranties once a sale seems firm, and it is the electronics store, not the manufacturer, that is offering them. Such bundling with a sale has the additional advantage of rolling the two costs into one price. Raising the cost of a \$620 item to \$690 is more likely to get a sale than setting a new \$70 price for the warranty, for example, of a camcorder.

$$\int_x^{.25} (8 - 32y)(x - .02)dy.$$

The optimal price is 0.097, or nearly 10 percent of the purchase price. This is nearly five times above actuarial value and well above the mean value in the population.

Monopoly pricing will not work if the buyers draw appropriate inferences from the situation. People who ask why the store is willing to sell insurance will conclude that it is only because the warranty makes money, and real sophisticates will recognize the monopoly situation. Hence they will decline the offer. Fortunately for electronics stores, even relatively informed people are poor at drawing appropriate inferences.<sup>87</sup>

Monopoly pricing also will not work if people underestimate the risk probability. We suspect this occurs in some situations where insurance is not sold. But as we learn from prospect theory, most people overestimate the risk of small-probability events.

### *Summary*

We posit three explanations for the poor performance of insurance markets beyond the traditional explanations surrounding moral hazard and adverse selection: contracting difficulties on the supply side, leading to incomplete diversification; nonstandard behavior on the demand side; and probability monopoly. Given the vast divergence between the theory of insurance and actual practice, students of insurance must extend current theory, often in unfamiliar directions. We believe these are promising paths for the future.

### **Conclusions**

The U.S. government recently enacted the largest expansion in health insurance coverage in a generation. The Medicare program, set up in the 1960s and largely the same today as then, was enriched in 2003 by the addition of an outpatient prescription drug benefit.<sup>88</sup> In many ways, adding

87. In a somewhat parallel situation, few bidders correct sufficiently for the winner's curse.

88. Prescription medications used on an inpatient basis are already covered in Medicare hospital payments. For simplicity, we refer to the new benefit as prescription drug coverage, leaving implicit the restriction on medications taken on an outpatient basis.

prescription drugs to Medicare represented a triumph of economic reasoning. The fundamental principle of insurance demand is that coverage becomes more valuable as the variability of potential outcomes grows. In the 1960s, prescription drug costs were low, and little risk was associated with buying medications. It made little sense to include prescription drugs in coverage. By 2003, the risks for the elderly were much greater. Even though the costs to the government were high, the potential risk-spreading value made offering the new benefit worthwhile.

Unfortunately, effective risk sharing was not fully enshrined in the new legislation. Indeed, the cost sharing in the new legislation is, by economic considerations, somewhat bizarre. Elderly enrolling in the new program face a \$250 deductible. After that, the government pays 25 percent of the bill up to \$2,250 in total spending. The government then ceases payment until total spending reaches \$5,100 (\$3,600 of individual costs). Above that amount, the government pays 95 percent and the individual 5 percent. There is no upper limit on individual spending.

From a risk-spreading perspective, a far more valuable insurance policy would have individuals cover more of the up-front costs and leave the government to take more of the back-end liability. Politics no doubt help to explain the benefits structure, complemented perhaps by the type of utility anomalies discussed above. A certainty equivalent benefit of \$110, where the actual monies go to 10 percent of the elderly population, may be politically less effective than a certainty equivalent benefit of \$100, where a large share of the money is spread broadly across the population.

The new legislation also considers the issue of public and private insurance, but here too the answer seems strange. Why does the private sector not offer insurance for prescription drugs if that coverage is so valuable? The answer is that drug benefits are almost a poster child for adverse selection. The elderly with high drug needs know who they are, and they would raise the cost of private drug coverage beyond what the vast majority of elderly would consider paying.<sup>89</sup> Given sufficient skewness in expenditure, the market unravels.

89. There is substantial evidence of adverse selection for prescription drug coverage in the Medigap insurance market, which sells supplements to the standard Medicare package (see Atherly 2002). Pauly and Zeng (2003) simulate a private market for prescription drug coverage allowing for reasonable degrees of adverse selection and conclude that such a market is not feasible.

Still, the new legislation envisions the majority of the elderly obtaining coverage through private insurance companies offering stand-alone pharmaceutical coverage. The classic economic solution to adverse selection—single-payer health insurance—was explicitly rejected as being too regulatory a solution. To partly offset the selection incentives induced, the legislation includes a substantial sum for employers already providing drug coverage—28 percent of costs between \$250 and \$5,000 per person. It is not known if this subsidy will prevent crowding out.

Unfortunately (for economists), the seeming anomalies in the Medicare drug benefit are more common than we would care to admit. Exploring a number of insurance policies in practice, we argue that the conventional theory of insurance misses reality in two respects. First, it assumes near risk neutrality on the supply side of the market, when in fact strong risk aversion is more appropriate, particularly given the agency concerns of insurance decisionmakers. Second, we show that many attributes of insurance outcomes can best be explained if people's behavior diverges from the rational model, meaning that they have nonstandard preferences: for example, they care about even tiny losses; they seek to equate utility across states, not marginal utility; they disproportionately buy coverage for risks that are "available."

We also identify possible solutions. Encouraging greater risk spreading beyond the narrow confines of primary insurance and reinsurance is a central one. Government and private firms sometimes collaborate in this venture, as in terrorism insurance, where the government is a reinsurer. More generally, financial markets represent an enormous pool of largely untapped potential insurance dollars.

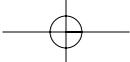
The future, we are confident, will confront significant new risks and will develop new mechanisms for spreading them. Unfortunately, neither the invisible hand nor sophisticated theories of insurance will assure that the right entities write the right coverage for the right group of insured. Our theories of insurance must be elaborated to capture realities on the ground, including the factors that motivate entities to insure. Insurance practice should be adjusted to meet realistic expectations of how risks can be spread effectively. This ongoing minuet of adjustments—perhaps a dance over decades—should allow the theory and practice of insurance to reunite.

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*David M. Cutler and Richard Zeckhauser*

51

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