

A PUBLIC POLICY MONOGRAPH

On Risk Classification

November 2011

American Academy of Actuaries
Risk Classification Work Group



AMERICAN ACADEMY *of* ACTUARIES

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Developed by the Risk Classification Work Group
of the American Academy of Actuaries



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RISK CLASSIFICATION MONOGRAPH

This monograph was developed by the Risk Classification Monograph Work Group of the American Academy of Actuaries at the request of the Academy's Risk Management and Financial Reporting Council. Its purpose is to provide background and information to the public regarding the purpose of risk classification and the design and management of risk classification systems. It is also designed to provide a systematic development of these concepts for actuaries and other professionals in a form applicable to all areas of actuarial practice. This monograph was not promulgated by the Actuarial Standards Board or any other standards-setting body, is not an actuarial standard of practice, and is not binding upon any actuary. No obligation is intended to be imposed on any actuary by this monograph, nor should such an obligation be inferred from any of the ideas expressed or suggestions made herein.

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Members of the Academy and others are encouraged to share their comments on this monograph with the Risk Management and Financial Reporting Council of the Academy to facilitate improvement in any future work product on this topic. Comments should be submitted to the Academy's analyst for Risk Management and Financial Reporting at rmfrcpolicyanalyst@actuary.org.

2011 Risk Classification Work Group

Arnold A. Dicke, MAAA, FSA, CERA, FCA, Chairperson

David Christianson, MAAA, FSA

Christopher Diamantoukos, MAAA, FCAS

Sam Gutterman, MAAA, FSA, FCAS, CERA, FCA, Hon FIA

Burton Jay, MAAA, FSA, FCA

Barbara J. Lautzenheiser, MAAA, FSA, FCA

Mark Litow, MAAA, FSA

Warren Luckner, MAAA, FSA, CFA

W. H. Odell, MAAA, ACAS, FSA, FCA

Julia T. Philips, MAAA, FSA

Chester J. Szczepanski, MAAA, FCAS

Joseph Tan, MAAA, FSA, Ph.D., FLMI



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1850 M Street N.W., Suite 300
Washington, D.C. 20036-5805

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Note: Many of the terms found in this monograph are in common usage, but with meanings that often vary with user and context. To facilitate careful analysis, many terms are defined in the full text that follows the Executive Summary. Such terms are italicized upon first appearance; a full set of definitions is recorded in the Glossary found at the end of the monograph. These terms are also italicized when they first appear in the Executive Summary.

EXECUTIVE SUMMARY

Uncertainty about the future affects everyone. Outcomes might prove to be better or worse than expected. The possibility of adverse outcomes is a cause of concern for individuals.¹ In response to *perils* that could cause injury or loss, mechanisms have been developed that enable individuals to mitigate, at least in part, the unfavorable financial or personal effects of the *risks*² created by these perils. Mitigation often takes the form of *advance risk transfer*—a commitment by one party to take specific action to mitigate any adverse impact of specified risks that face another party. This monograph focuses on *financial or personal security systems* (or *security systems*)—private or governmental arrangements for advance risk transfer—and on the important role that risk classification can play in assuring that such systems are successful.

A security system consists of one or more *coverage providers*³ that *provide coverage* to the *participants* in the security system for specified *covered risks*. Life and health insurance, property and casualty insurance, and retirement systems are all examples of security systems. Some security systems provide mitigating benefits in the form of monetary payments, while others provide such benefits in the form of goods or services such as automobile repairs, prescription drugs or medical services.

A security system is either *voluntary* or *compulsory*, depending on whether participation is required of all members of a specified group. The economic impact of permitting individuals to make choices about participation and other matters can be significant for both voluntary systems and *compulsory systems with elements of choice*. If elements of choice are present, factors considered in the design of voluntary systems are also relevant to the design of compulsory systems.

¹ In this monograph, “individual” may refer to individual persons or entities or, in certain cases, groups of persons or entities or a person acting as a decision maker for a group of persons or entities.

² The term “risk” is used in many different ways, often as a synonym for “uncertainty.” In economics literature, a distinction often is made between risk and uncertainty: “risk” is used when probabilities of possible outcomes are known or at least estimable; “uncertainty” is reserved for situations where such probabilities cannot be estimated. The definition of risk used in this monograph is consistent with this usage.

³ In this monograph, the term “coverage provider” is used for those entities, including insurance companies, employee benefit plans and governments, that provide coverage for covered risks, while the term “service provider” is used for physicians, hospitals, and others that provide services directly to individuals without assuming risk. A service provider may be part of the security system, as is the case for pre-paid health plans, or may be independent of the security system. Some entities, such as health maintenance organizations and continuing care retirement communities, may function as both coverage provider and service provider.

Security systems also differ in the degree of competition among coverage providers. Some security systems are *fully competitive*, having multiple coverage providers that are free to offer *terms of coverage*, including prices and benefits, of their choosing among which potential participants are free to choose. In contrast there are *single-coverage-provider systems*, including many government- and employer-sponsored systems. The degree of competition that exists affects the incentives and constraints that apply to coverage providers, participants and other interested parties. These incentives and constraints are important considerations in the design of a security system.

Since security systems are used to provide mitigation for a wide variety of risks, the criteria that must be satisfied for a security system to be successful will vary from system to system. For the satisfaction of a set of criteria to be sufficient to imply the success of a system, the set of criteria must reflect many goals and requirements specific to the system—goals and requirements relating to the risks covered, the *at-risk group*, the coverage providers and the purposes of the system. Many security systems, including life, health and property and casualty insurance and pension plan systems, both public and private, are intended to serve the needs of a broad at-risk group over a long time horizon. This intent may be incorporated into the design of such systems by recognizing the need to satisfy the following three “success criteria”:

- (i) Coverage is widely available to those in the at-risk group who desire it.
- (ii) The terms of coverage, taken as a whole, are sufficiently acceptable to those eligible to be participants.
- (iii) The security system will have access to sufficient resources to fulfill its promises.

This monograph applies to security systems for which these success criteria are recognized as necessary (although not necessarily sufficient) for the success of the system. Such systems may have other goals, including those relating to public policy, but for the system to be successful, its design must also provide for a high degree of satisfaction of each of the three criteria.

Under the terms of coverage, a coverage provider agrees to take specified mitigating actions, such as payment of a benefit or provision of a service, upon the occurrence of specified *covered events*. The probability that a specific outcome of a covered event will occur at a given time and be of a given *severity* is its *risk probability*. Before any covered event occurs, the *expected cost of providing coverage for a covered risk* may be estimated. In contrast, the actual cost of coverage will depend on which outcome actually occurs and is likely to be more or less than the expected cost. Risk classification, the subject of this monograph, can be a means for facilitating and improving estimates of the expected cost of coverage. *Necessary additional provisions* include any provisions for fluctuations of the actual cost around the expected cost, for uncertainty related to the

process of estimation, for expenses and for profit or contribution to surplus. Risk classification also can facilitate and improve estimates of these items.

Systems may adopt prices for coverage that are related to the expected cost of coverage for the covered risks and that retain this relationship even after they are augmented by any of the necessary additional provisions. This effect on each of the success criteria of this approach to pricing is as follows:

Coverage is widely available to those in the at-risk group who desire it. If, in a system with multiple competing coverage providers, the prices bear a reasonably uniform relationship to the expected cost augmented by any of the necessary additional provisions, each coverage provider will receive a large enough payment for each covered risk to offset its augmented estimated cost and thus will be motivated to offer coverage for all potential covered risks, even those with high expected costs of coverage. In a single-provider system, the participation and coverage limitations may be based on considerations other than the prices charged to participants, but over the long term, a shortfall in funding may lead to increased restrictions of participation and coverage.

The terms of coverage, taken as a whole, are sufficiently acceptable to those eligible to be participants. While participants all prefer a lower price, prices that are reasonably related to the perceived cost of coverage are more likely to be understood and thus to achieve broad acceptance than would prices that are not related to the perceived cost of coverage. To the extent prices for coverage within a security system are reasonably proportional to the corresponding expected costs of coverage, the system is said to achieve *individual equity*. If some individuals are charged more and others less than the expected cost of providing coverage augmented by any necessary additional provisions, the security system's pricing structure involves *internal subsidies*. If a security system depends on the receipt of resources from a source outside the system in addition to the payments received from participants, the security system's pricing structure involves *external subsidies*. Although individual equity is not a necessary condition for the success of a security system, if a system is not based on individual equity, careful design of the terms of coverage and more frequent monitoring of the success criteria would be needed to achieve success.

Systems that achieve individual equity often are perceived as fair by participants since the amount each participant pays is reasonably related to his or her expected cost of coverage. But “fairness” can mean different things to different people. The term *social adequacy* sometimes is used to describe the goal of making coverage available to all or most of a group at prices that are deemed affordable. If a security system has social adequacy as a major goal, prices may not be set to be consistent with individual equity.

The system will have access to sufficient resources to fulfill its promises. Finally, a pricing structure that reflects the augmented expected cost of coverage will tend to have sufficient resources to fulfill the promises it makes. If its prices do not reflect expected cost of coverage, a security system is susceptible to *adverse selection*. Adverse selection can result when one party to a transaction has relevant information that is not available to or not used by the other party. Adverse selection can occur in a security system when a potential participant intentionally withholds relevant information. It can also occur if a coverage provider is not allowed or chooses not to obtain or use information about certain conditions or facts concerning the potential participant. The effects of adverse selection can be quite detrimental to a security system’s financial soundness. In designing a security system with social adequacy as a goal, controlling adverse selection is an important consideration. If it is not controlled, the system may require an ever-increasing level of subsidies.

A coverage provider for a security system faces the practical problem of how to estimate expected costs of coverage based on the information available to it. To solve this problem, a coverage provider might group covered risks it knows or believes to have similar *risk probabilities* into *risk classes*. For example, life insurers group together covered risks they believe to have similar probabilities for the death of the insured occurring in each future period. Risk probabilities are the probabilities of the possible outcomes associated with the covered risk; each outcome reflects both timing and level of severity. If a risk class includes a sufficient number of covered risks, its risk probabilities often can be estimated by observing outcomes over time. These estimates can be used in turn to estimate expected costs of coverage for the risks in the risk class. As a result, estimates of expected costs are greatly facilitated by the establishment of an effective *risk classification system*.

Many covered risks are associated with specific persons, objects or entities; a property insurance risk, for example, may be associated with a specific house. Any such person, object or entity is called a *risk subject* of the covered risk. Observable qualities of the risk subjects that provide useful information about the risk probabilities associated with a covered risk are called *risk characteristics*. A risk classification system often assigns risks to risk classes based on the values of one or more risk characteristics. Since not every observable quality of a risk subject provides information that is sufficiently useful for this purpose, not every observable quality is a risk characteristic.

In designing a risk classification system, selecting the risk classes to use is pivotal. Having fewer risk classes means each risk class will have a greater volume of historical data on which to base estimates of its risk probabilities. If, however, some of the risk classes are insufficiently homogeneous, the coverage provider could be subject to adverse selection.⁴ The selected number of risk classes, therefore, reflects a balance between the desire to minimize adverse selection and the desire to maximize the volume of historical data available for each risk class. When risk classes can be made more homogeneous by increasing the number of risk classes or by some other means, prices can reflect a greater degree of individual equity.

Risks are dynamic—they can and do change over time. The dynamic nature of risks has important implications for the design of a risk classification system. For example, in voluntary systems or compulsory systems with elements of choice, if the terms of coverage restrict the reclassification of a risk after participation begins, the risk classes may become increasingly inhomogeneous⁵. Attempts to increase the price of coverage applicable to insufficiently homogeneous risk classes, regardless of the cause of the inhomogeneity, can lead to destructive *price spirals*.

Useful estimates of the risk probabilities for a group of covered risks might be based on historical data regarding frequency of occurrence and severity observed for these covered risks, provided the covered risks are sufficiently plentiful and substantially similar to one another. In some cases, the relevance of data from historical studies might be limited if either the conditions under which they were observed or the mix of risks is dissimilar to that which is to be expected in the future. If appropriate risk classes have been established but historical data are either insufficient or no longer relevant, reasonable estimates of risk probabilities might be based on other sources, such as historical data obtained for other similar risks, studies of a single risk characteristic or of the interaction of a number of risk characteristics, and the judgment of a qualified professional acting in accordance with professional standards of practice.

Whatever method is used to develop estimates of risk probabilities and thus of expected costs of coverage, the use of a risk classification system can promote internal consistency of the estimates, decrease the likelihood of adverse selection and facilitate the tracking of data.

⁴ Such risk classes may include some risks with expected costs that significantly exceed the price for coverage and other risks with expected costs that are below the price. In such cases, the coverage may appear inexpensive to some participants and expensive to others. Potential participants to whom the coverage appears inexpensive are more likely to participate than those to whom the coverage appears expensive. See Section II.C below for a more complete discussion of this point.

⁵ The term “inhomogeneity,” defined as “the condition of not being homogeneous,” is often used in scientific contexts, especially to describe a part that is not homogeneous with the uniform mass in which it occurs. The term “heterogeneity,” synonymous to “diversity” or “variety,” is sometimes used. Cf., Merriam-Webster Online, www.merriam-webster.com.

When an effective risk classification system has been established, the coverage provider is better able to estimate risk probabilities for each risk class and thus the expected costs for risks in the class. By facilitating the estimation of expected costs of coverage, a risk classification system helps the security system to satisfy the three success criteria identified above as necessary, although not necessarily sufficient, for the success of the security system. An effective risk classification system, therefore, can play a critical role in the success of a security system.

To be effective, a risk classification system must be carefully designed. Design flaws that seem innocuous at first can become unmanageable over time. In addition, the design must be reviewed and necessary changes must be made to reflect the inevitable changes in the nature of the risks and the circumstances in which the security system operates. This is true for both voluntary and compulsory systems and for both competitive and single-payer systems. Improper design has proven over time to lead to the failure of both small privately-run systems and large governmental systems.

Both the initial design and the maintenance of the risk classification system depend on the type of security system and the system's goals, which in turn could be affected by organizational, social and legal considerations.

It is usually desirable that a risk characteristic be objective and measurable and that potential participants cannot easily manipulate or control the value of the characteristic. In cases in which a specific quality of the risk subject can be shown to be correlated to a risk probability, the quality provides sufficient useful information for it to be used as a risk characteristic. The existence of a persistent correlation often prompts a search for an explanation that takes the form "A causes B." A cause and effect explanation sometimes is readily apparent. This is true, for example, for the correlation of a prior heart attack with shortened longevity. Sometimes, however, a statistical correlation may be well-established, but a cause and effect explanation may not be evident. In such cases, introduction of additional risk characteristics might facilitate a more accurate assessment of the relevant risk probabilities.⁶

Other considerations in establishing risk classes include absence of ambiguity, proper balance between homogeneity and credibility, avoidance of overly large discontinuities and considerations of expense and practicality.

Due to the dynamic nature of risk, changes might be required from time to time to maintain the effectiveness of the risk classification system. In some cases, simply changing the prices or other terms and conditions applicable to the various risk classes may suffice. In other cases, the risk classes themselves may need to be updated. Different considerations apply if changes are made to risk classes only for new participants than if

⁶ This point will be discussed more fully, and examples will be given, in Section IV.C.1.c below.

changes are made to the classification of risks already covered by the security system.

In the design of a security system intended to last for a period that exceeds the life expectancy of most participants, the temptation to “borrow from the future” to permit current benefits to be provided at less than expected cost is always present. Risk classification can provide a means to deal explicitly with this “generational equity” problem.⁷

Any risk classification system must be designed with awareness of the values of the society in which it is to operate. This is a particularly difficult principle to apply in practice, because social values are difficult to ascertain, can vary among segments of the society and can change over time.

Since risk classification may result in higher prices or less favorable terms of coverage for some risks than for others, questions may be raised from time to time by consumers, legislators, jurists and regulators. Some question the applicability of statistics to matters that affect individuals. One answer to this objection is to note that risk classification classifies risks, not risk subjects. Furthermore, an attempt to offer coverage to risks without reference to their respective risk probabilities is likely to lead to significant adverse selection and eventual failure of the security system.

Other critics accept the concept of risk classification but raise concerns with its implementation in specific situations. For example, a risk classification system may be criticized on the grounds that the relevance and predictive ability of a specific risk characteristic have not been sufficiently established. A commitment to continue to update risk classifications and terms of coverage as current relevant data become available is one way to achieve greater acceptance in such situations. Availability of coverage from a number of coverage providers in a competitive market also can help alleviate these concerns, since the providers are likely to assess situations that have limited data differently and thus to offer a wide range of choices regarding coverage and price.

Both federal and state laws recognize the validity of risk classification principles; nevertheless, legislators and regulators on occasion have adopted laws and regulations that constrain or put limits on risk classification.⁸ These actions often have been taken as a result of specific individual circumstances and the public concern that these circumstances give risk to. Legislators, in these situations, face difficult choices: being responsive to public concern, while recognizing the need for the preservation of the principles that underlie continued effective functioning of public and private security systems. If such principles are disregarded in the legislative or regulatory decision-making process, the concerns that motivated the resulting laws or regulations could prove

⁷ This issue is more fully discussed in Section IV.D.4 below.

⁸ Examples are given in Section IV.E.3 below.

less significant than the problems that they cause in the future.

The threat to the system's ability to fulfill its promises that can result from adverse selection is often recognized as a cause for concern. Such legal and regulatory restrictions, however, also can result in reduced availability of coverage and in prices and other terms of coverage that are viewed as inequitable and therefore unacceptable by many potential participants. The ultimate impact on all three success criteria, therefore, should be evaluated whenever restrictions on risk classification are under consideration.

SECTION I

BACKGROUND: FINANCIAL OR PERSONAL SECURITY SYSTEMS

Uncertainty about the future affects everyone. Outcomes can prove to be better or worse than expected. The possibility of adverse outcomes is a cause of concern for everyone. To address these concerns, mechanisms have been developed that enable individuals⁹ to mitigate, at least in part, the unfavorable financial or personal impact of such outcomes. This section discusses pertinent aspects of these mechanisms.

A. RISKS AND RISK SUBJECTS

A *peril* is a cause of possible injury or loss at times in the future. When a peril exists, no one can know exactly which, if any, of the possible outcomes will occur. But it is often possible to describe the outcomes that could occur—Ms. X dies on Jan. 1, 2012; Mr. Y has a heart attack on Jul. 4, 2025; the house at 123 Main Street is 25 percent damaged in an earthquake on Dec. 18, 2013. Note that the possible outcomes associated with a peril involve the occurrence or non-occurrence of injuries or losses at specific future times. Having knowledge of or, at least, the ability to estimate the probability of each possible outcome improves understanding of the situation created by a peril. The term *risk*¹⁰ will be used in this monograph to mean a situation, created by a peril that gives rise to a defined set of potential outcomes and the probability of occurrence associated with each outcome.

Risks can be *monetary* (having outcomes that are expressed in monetary terms) or *non-monetary* in nature. The non-monetary risks associated with a house fire include the risk of physical damage, as well as the risks of inconvenience and emotional upset, while the monetary risks include the risk of incurring expense to repair the structure or to provide temporary housing to the occupants. Since a fire can result in damage to any part of the house and to any of the contents of the house, the list of possible outcomes for the risk of physical damage is (infinitely) long. The possible outcomes for the monetary risk are the amounts that must be paid at each future time: nothing if no fire occurs at that time and the amount it would cost to repair or replace the damaged property and provide temporary housing if a fire does occur. A specific monetary outcome (for example, a loss of \$10,000 on Dec. 2, 2013) could be associated with several different physical outcomes

⁹ In this monograph, “individual” may refer to individual persons or entities or, in certain cases, groups of persons or entities or a person acting as a decision maker for a group of persons or entities.

¹⁰ The term “risk” has been used in many different ways, often as a synonym for “uncertainty.” In economics literature, a distinction is often made between risk and uncertainty: “risk” is used when probabilities of possible outcomes are known or at least estimable; “uncertainty” is reserved for situations where such probabilities cannot be estimated. The definition of risk used in this monograph is consistent with this usage.

(for example, the destruction of a painting valued at \$10,000 or the damage to walls and ceilings that costs \$10,000 to repair on that date).

The *severity* of a particular outcome of a monetary risk is the monetary loss associated with the outcome. If the monetary loss consists of a series of payments, the severity is the *current monetary value*¹¹ of the payments at the time the event occurs. The current monetary value of a series of current or future payments is the amount that is determined to be needed at a specified time to provide for current and future payments.

The *risk probability* of an outcome associated with a monetary risk is the probability that the outcome occurs at a particular time and is of a particular severity. The risk probability associated with an outcome thus reflects both the outcome's timing and the outcome's severity. To illustrate:

- For a \$100,000 life insurance policy on a 40-year old man, the risk probability for the outcome “benefit becomes payable while the man is age 60” is the probability that the man dies at that age; i.e., the mortality rate. The severity is always \$100,000, so the risk probability only reflects the timing of the outcome.
- For a disability income policy, the monetary loss could be the payment of a fixed monthly benefit for a period of time described in the policy. The severity is the current monetary value of these payments. The severity thus depends on how long the benefit is paid. The risk probability reflects the onset of disability. It also reflects the different levels of severity that correspond to different rates of recovery.
- The risk probability for major medical insurance reflects the probability of suffering various illnesses and injuries, as well as the associated severities. The monetary loss may occur in the form of a single payment or a series of payments and the size of the payments will vary. The severity depends on when payments are made and how large the payments are.

In this monograph, the risks addressed will be monetary risks unless specifically stated otherwise.

Risks often are associated with a specific person or thing or with collections of persons and things. A life and health insurance risk, for instance, is associated with a specific

¹¹ The current monetary value assigned to an economic good or service at a particular time by a participant or a coverage provider is an amount of money such that the participant or coverage provider is indifferent between the amount of money and the economic good or service. Current monetary value takes into account time value of money, willingness to take risk and other considerations. In this monograph, if the identity of the participant or coverage provider is clear from the context, it may not be stated.

human being and a collision risk is associated with a specific automobile. A *risk subject* is a person or thing, or a collection of persons or things, associated with a risk. Although the unmodified word “risk” often is used for both risks and their risk subjects, care will be taken to distinguish the terms in this monograph. If, for example, Ms. A is covered by a medical expense insurance policy, the risk subject is Ms. A and the risk for the health insurance company is described by the complete list of payments that possibly could be required under the policy for all covered medical conditions that might afflict Ms. A, together with the risk probabilities. Numerous risks may be associated with the same risk subject. In addition to being the risk subject for medical expense risk, Ms. A also could be the risk subject for life insurance risk and workers’ compensation risk, as well as for non-monetary risks such as the risk of personal unhappiness.

B. PERIL AVOIDANCE AND RISK REDUCTION

Some perils can be avoided. The chance of adverse reaction to a specific vaccine, for example, can be avoided by not taking it. The risks created by other perils can be minimized. The likelihood of being injured in an airplane accident can be reduced greatly by not flying. It cannot be eliminated totally, as on rare occasions people on the ground have become victims of airplane crashes. The incidence and severity of injury or loss associated with other perils can be reduced significantly by taking appropriate safety precautions. Periodic maintenance of the electrical systems of a building, for example, may reduce the incidence of fires in that building, and both smoke detectors and automatic sprinklers may reduce the severity of fire losses. Taking such precautions may be called “risk reduction.”

Avoiding perils and employing risk reduction techniques could result in costs, including opportunity costs, and increased exposure to other risks. This was the case in each of the examples just given: installing sprinklers is expensive, avoiding air travel could result in the loss of profitable business, and not taking a vaccine for a disease increases the likelihood of contracting the disease. There are individuals who decide to live with risks rather than incurring the costs and risks inherent in eliminating or reducing them.

C. TRANSFER OF RISK

Risks can result in adverse financial or personal consequences to an individual. If available resources, such as personal savings, are sufficient to easily offset these consequences, additional mitigating action may not be needed. In situations in which this is not the case, ignoring the potential impact of such risks could be undesirable. Accordingly, various approaches have been devised to mitigate such impact. Mitigation of the adverse consequences of an uncertain event often is provided by families, friends, privately funded charities, or government assistance, among others. Mitigation also is provided by governmental or private insurance programs or prepaid service plans.

These mitigation options differ in that some provide some degree of *advance risk transfer*—a specific commitment by one party to mitigate the impact of certain risks that face another party—while others do not involve any such advance commitment. Insurance and prepaid service programs, for example, normally are formalized in contractual form in advance of any occurrence of injury or loss and require payment to the entity accepting the risk. These programs provide advance risk transfer. Other programs mitigate the impact of an event after the event occurs, without a formal contract or other advance commitment. While both approaches can mitigate the negative consequences of uncertain events, programs based on advance risk transfer also can mitigate the uncertainty the individual faces before any loss has occurred and thus may provide an enhanced sense of security.

In this monograph, a group of individuals or entities facing possible unfavorable outcomes arising from one or more specified uncertain events is called an *at-risk group*.¹² Retirees, for example, form a group that is at risk for outliving available financial resources. A private or government-sponsored arrangement that is intended to offer a means to mitigate the impact of such unfavorable outcomes on some or all of the members of an at-risk group through advance risk transfer is called a *financial or personal security system (or security system)*. A private pension system and U. S. Social Security are examples of security systems that are intended to offer means to mitigate the impact of outliving one’s financial resources. A security system *covers* or *provides coverage for* those who participate in the system, the *participants*.

A *coverage provider* is an entity associated with a security system that agrees to take actions that mitigate the unfavorable outcomes of specified risks through advance risk transfer in return for payments or other consideration. Examples of coverage providers are insurance companies, pension plans and pre-paid health plans. For Social Security and Medicare, the government is the primary coverage provider although for Medicare the government contracts with private companies to cover some of the risk. In some security systems, one entity may carry out the actions that mitigate unfavorable outcomes, while another entity is responsible for reimbursing the cost of these actions. In such systems, the second entity is the coverage provider. In cost-plus insurance systems, for example, the “insurer” pays claims to the participant, but the plan sponsor (which may be an employer or a government agency) reimburses the insurer for the full amount of the claim payments (and also pays an additional amount to cover the insurer’s administrative expense). In such cases, the coverage provider is the plan sponsor, not the insurer. While the issues addressed in this monograph may not be important to the intermediary, they are important to the actual coverage provider and thus to the success of the security system.

¹² The term “at-risk group” often is used to mean a group that is particularly susceptible to incidence or severity of loss. In this monograph, the term will be not be used in that sense, but rather in the more general sense given in the text.

In some security systems, mitigation of unfavorable outcomes primarily takes the form of monetary payments. Examples are auto insurance, homeowners insurance, life insurance and pension plans. For other security systems, mitigation occurs primarily through the provision of services to the affected individual. For some security systems, mitigation is accomplished through a combination of payments and directly-provided services. In this monograph, the term “coverage provider” is used for those entities that provide coverage for covered risks, while the term *service provider* is used for physicians, hospitals, and others that provide services directly to individuals but do not take part in advance risk transfer for the covered risks.¹³ A service provider may be part of the security system, as is the case for pre-paid health plans, or may be independent of the security system. Some entities, such as HMOs and continuing care retirement communities, may function as both coverage provider and service provider.

For a specific coverage offered by a coverage provider, the *terms of coverage* is a description of the rights and responsibilities of the coverage provider and of the participants to whom it provides coverage. A *covered event* is an event with one or more outcomes that require the coverage provider to take mitigating actions involving monetary payments or the provision of goods or services, as provided under the terms of the coverage. For example, homeowners’ policies list events such as damage to a structure caused by such perils as fire and earthquakes, as well as limits and deductibles that are used to determine the amounts paid if the event is covered. Any event with an outcome that satisfies the limits and deductibles (e.g., damage due to an earthquake that results in a monetary loss greater than the deductible) is a covered event under the policy. The mitigating action for a covered event under the policy is the payment of the amount or amounts determined under the terms of coverage. The definition of covered event also includes events with outcomes that only partially meet the requirements for mitigating actions to be taken. For coverages such as high-deductible medical policies issued in conjunction with health savings accounts and stop-loss coverages, for example, the occurrence of covered events prior to the satisfaction of the deductible does not result in immediate payments but increases the likelihood that such payments will be received in the future. Meeting the conditions for vesting under a pension plan does not by itself meet the requirements for pension payments since the participant must be alive at the time payments are scheduled to start, but is a step on the way to meeting the requirements. Vesting is thus a covered event for the pension plan.

The mitigation of unfavorable outcomes of a covered event results from the transfer of risk from the participant to the coverage provider. A *covered risk* associated with a security system is a risk for which the possible outcomes are the mitigating actions that would be undertaken by a coverage provider upon the occurrence of one or more of the

¹³ The service provider may face other risks, such as the risk of being sued for malpractice, which are distinct from the covered risk. In this monograph, the term “service provider” will not be used, as may be done in other contexts, to describe entities that supply administrative services to participants and coverage providers.

system's covered events. Mitigation of the covered risks is among the responsibilities of the coverage provider, as well as among the rights of the participants, and thus is described in the terms of coverage. For some risks, it may be possible to describe the covered risk by enumerating the covered events and the mitigating actions that would be taken upon their occurrence. But, for most coverages, enumeration is not possible and the covered risks are described in more general terms. Under a life insurance policy, for example, the payment to be made at death usually can be stated explicitly, even when the amount of payment depends on how long the coverage has been in force or on other conditions. On the other hand, the terms of coverage for a homeowners' policy usually provide a description of the covered events, such as damage to a dwelling by fire, water, etc., and of the basis for determining the mitigating payments, including caps, co-payments, deductibles and other limitations.

To manage the risks that have been transferred to it, a coverage provider in a security system may itself need to transfer some of the risks it has assumed. In such situations, security systems may have multiple tiers, with the coverage providers from one tier receiving coverage from coverage providers in the next higher tier. Insurance companies subject to risks associated with providing coverage to individuals, for example, may obtain full or partial coverage for this risk from a reinsurer. The reinsurer may, in turn, obtain coverage from a coverage provider in the next higher tier (called a "retrocessionnaire"). This multi-tier structure can enable the security system to provide increased risk-taking capacity with increased flexibility in terms of coverage.

Employee benefit programs that utilize group insurance are another example of a multi-tier security system. The employer sponsors an employee benefit plan that provides coverage for certain risks faced by employees. The plan, in turn, enters into a group insurance arrangement that transfers some or all of these risks to an insurance company.

Such multi-tier security systems may be distinguished from security systems in which a second coverage provider provides back-up coverage to the participants if the primary coverage provider is unable to fulfill its promises. Examples of security systems with "back-up" coverage providers include voluntary insurance systems, in which back-up is provided by state guaranty associations, and the U.S. defined benefit pension system, in which back-up is provided by the Pension Benefit Guaranty Corporation.

D. COMPULSORY AND VOLUNTARY SYSTEMS

A security system is *compulsory* if it provides coverage for a specified group and all members of the group are required to participate. If an individual has the right to choose whether or not to participate, the security system is *voluntary*.

Government-sponsored security systems are usually established by public law, while coverage provided through private security systems is established by contractual

arrangements involving participants and coverage providers. Government-sponsored systems often are compulsory, but may be voluntary with respect to some benefits or other provisions. An example is the Medicare Part D prescription drug benefit, which is voluntary, while Part A basic medical coverage is not. Private systems often are voluntary (e.g., individual life insurance) but also can be compulsory (e.g., those forms of group life insurance under which all the employees of the sponsoring employer must participate). When coverage is required by laws or regulations, it may be provided by governmental plans such as Social Security or by private plans as may be the case for auto insurance and workers' compensation. Such coverage also may be provided by combinations of private and governmental programs. Compulsory security systems may be established when coverage cannot be provided effectively by a voluntary security system—when, for example, the perils represent a type of risk that cannot be effectively covered by a voluntary system or some members of the group cannot afford the cost of the coverage and as a result need to be subsidized. It is possible to have associated security systems in which one system is compulsory and the other voluntary. This would be the case, for example, if an employer established an employee benefit plan in which employees were required to participate and then obtained group insurance coverage in the open market.

E. INDIVIDUAL CHOICE IN A FINANCIAL OR PERSONAL SECURITY SYSTEM

Participants in voluntary and many compulsory security systems can choose whether to participate and/or the extent and form of their coverage. The choices that an individual participant in a financial or personal security system can and does make can have important and often subtle effects on the effectiveness of the system.

1. Individual Choice in Voluntary Systems

Voluntary systems by definition allow the individual to choose whether to participate. Beyond this, a voluntary system may provide choices both at the time the participant enters the system and afterward. Many voluntary systems provide options to the participant about the level and type of benefit. Health and dental insurance plans, for example, may offer choices of deductible and co-payment, as well as of benefit limits.

Most, but not all, voluntary systems also offer a choice among coverage providers. Most insurance coverages, for example, are sold in an open market with many competitors.

2. Individual Choice in Compulsory Systems

In applying actuarial principles to compulsory systems, it is important to distinguish systems that are fully compulsory in operation as well as in concept from those that incorporate some degree of individual choice. In fact, it is difficult to design and implement a compulsory system that does not incorporate some elements of choice.

First, a purportedly compulsory system may permit some members of the covered group to elect non-participation. In other cases, the system may require, but may not be able to enforce, participation, resulting in a condition often referred to as “leakage.” This occurs, for example, with compulsory health insurance programs, when some of the targeted participants simply cannot afford the required payment. Leakage may also occur because some of the targeted participants perceive the cost of non-participation to be less than the payment required to participate. An example is non-compliance with the requirement to participate in a mandatory automobile insurance system.

Second, a financial or personal security system in which participation is compulsory may offer participants choices within the system similar to those offered by a voluntary system. A number of states, for example, give participants the unconstrained option of choosing between different levels of health coverage. A participant may be allowed to choose whether to include family members, select a level of deductible or make other choices internal to the system.

Third, again similar to voluntary systems, some compulsory security systems permit a choice among several coverage providers.

Compulsory systems in which the participant is able to make choices about coverage or coverage providers are called *compulsory systems with elements of choice*. To the extent elements of choice are present in a proposed compulsory system, their impact should be evaluated and, if unacceptable, the elements of choice may need to be modified or eliminated. To the extent that elements of choice are present, the factors that are considered in the design of voluntary systems are relevant to the design of compulsory systems.

F. THE ROLE OF COMPETITION

A financial or personal security system with multiple coverage providers that are free to offer terms of coverage and prices of their own choosing, and among which potential participants are free to choose, is a *fully competitive* system. The competitiveness of a security system may be affected if any limits are placed on the terms or prices that coverage providers may offer. A security system with only one coverage provider—a

single-provider system—is by definition not a fully competitive system.

Non-governmental financial or personal security systems usually have a number of competing coverage providers, while many governmental systems do not. Both compulsory and voluntary systems may provide for competition. For example, although an automobile insurance system in a state in which coverage is required by law is a compulsory system, it usually has a number of coverage providers competing with one another. On the other hand, there are compulsory systems that have more than one coverage provider, but do not have competition among the providers. Assigned risk pools, such as those set up in conjunction with legally mandated coverages, are examples of such systems.

Competition, by its nature, tends to provide certain advantages to participants and potential participants. First, as a result of competition, overall rates tend to be lower and terms of coverage tend to be more varied and, frequently, more favorable, because a coverage provider that is subject to competition must offer a combination of price and terms of coverage that will induce potential participants to purchase its coverages instead of those of a competitor.¹⁴

Second, coverage is more likely to be available, as are a wider range of prices and terms of coverage, because each coverage provider may assess a specific risk differently. This diversity of assessment occurs whether risks are highly predictable or are difficult to predict. In general, though, the less predictable the risk, the greater the diversity of assessments among coverage providers will be. The assessment of the effect on mortality of well known medical conditions such as heart disease or diabetes, for example, will differ among life insurance providers, but the variation in most cases will be slight. On the other hand, insurer assessment of hard-to-predict risks may vary widely, as it did in the case of business interruption insurance for the Y2K threat in the year 2000. It was almost impossible to estimate with reasonable confidence the risk of business interruption caused by computers using two-digit fields to represent calendar years—the "Y2K" threat. For any risk, each coverage provider's assessment will reflect the information available to the provider, the provider's risk-evaluation skills, and the provider's risk appetite. The resulting diversity in assessments often means that coverage for hard-to-predict risks will be available from some coverage providers, even if others are unwilling to offer it.

Security systems that are not fully competitive may have advantages in some situations. Individuals facing risks that have a high probability of unfavorable outcomes, for example, may not be able to afford desirable coverage, or indeed any coverage, without

¹⁴ Coverage providers often attempt to differentiate themselves from competitors through branding, superior service and in other ways. Because of this, the combination of price and terms of coverage that a provider must offer to succeed in enrolling participants may not be the same as those that must be offered by its competitors to achieve similar success in the marketplace.

some form of subsidy. In this case, even if there is general agreement that a subsidy is justified, it can be difficult to provide in a competitive market. It is difficult, for example, to find a method that will allocate the cost of the subsidy among coverage providers or participants so that none is disproportionately disadvantaged. The result, often, is that some coverage providers are required to provide services below cost or that some participants are asked or required to pay a higher price than otherwise would be the case for their coverage. Either of these results will be difficult to maintain in a fully competitive system. Systems that are not fully competitive may be better able to provide such subsidies.

Single-provider compulsory systems, such as Social Security and certain employer plans, also may realize cost advantages, as the cost of marketing and selection of risks may be unnecessary. In addition, administrative costs can be spread across a relatively larger group. Payments required to participate can be collected efficiently through existing compulsory systems—for example, Social Security deductions collected through the federal tax withholding system.

In comparing differently structured security systems, it is important to consider not only the stated goals of the systems, but also the incentives and constraints that each system establishes for coverage providers, participants and other interested parties. In a competitive system, for example, competitors generally are motivated by a desire for profit or, in the case of non-profit organizations, a desire to achieve their objectives and continue to exist. They may be constrained by laws, regulations and public opinion. In the case of a government-sponsored system, elected officials have to balance the interests of various constituencies. While offering increased benefits or more liberal terms of coverage will please some constituents, the actions taken by an elected official also may be affected by the need to fund the changes by taking unpopular steps, such as raising taxes or increasing public debt.

The incentives and constraints facing participants in financial and personal security systems depend on the design of the system, whether the system is fully competitive or not.

G. CHARACTERISTICS OF SUCCESSFUL FINANCIAL OR PERSONAL SECURITY SYSTEMS

What characterizes a successful financial or personal security system?

The purpose of a financial or personal security system, as noted above, is to provide a means by which the impact of unfavorable outcomes of uncertain events can be mitigated through advance risk transfer. Since security systems are used to provide mitigation for a wide variety of risks, the criteria that must be satisfied for a security system to be successful will vary from system to system. For the satisfaction of a set of criteria to be

sufficient to imply the success of a system, the set of criteria must reflect many goals and requirements specific to the system—goals and requirements relating to the risks covered, the at-risk group, the coverage providers and the purposes of the system. Many security systems, including life, health and property and casualty insurance and pension plan systems, both public and private, are intended to serve the needs of a broad at-risk group over a long time horizon. This intent may be incorporated into the design of such systems by recognizing the need to satisfy three “success criteria.” Three such criteria are often identified as being necessary, if not necessarily sufficient, for the success of any such financial or personal security system.¹⁵

1. Coverage is *widely available* to those in the at-risk group who desire it.

The first question a person who is faced with risk may ask is, “Is coverage available for this risk?” The question of availability is important for both compulsory and voluntary systems. In voluntary systems and in many compulsory systems, availability of coverage can depend on the willingness of coverage providers to participate in the system, which in turn may depend on the incentives and constraints that the coverage providers face. If coverage is provided in the form of services, availability of coverage also can depend on the willingness of service providers to participate in the system and their participation will depend on the incentives and constraints they face. In the case of compulsory systems, coverage may not be perceived as widely available unless the specified group itself is sufficiently inclusive and the range of risks covered is sufficiently broad.

“Widely available” does not imply universally available. Few security systems can provide coverage on acceptable terms to all members of the at-risk group. Nevertheless, expanding the availability of coverage, all other things being equal, will increase the likelihood that a security system will be successful.

2. The terms of coverage, taken as a whole, are *sufficiently acceptable* to those eligible to be participants.

Once the individual knows coverage can be obtained, his or her next question often involves the terms of coverage. Recall that the terms of coverage consist of a description of the rights and responsibilities of coverage providers and their

¹⁵ Simultaneous optimization of these three criteria likely would result in what economists call a Pareto optimal equilibrium, an equilibrium in which no one can be made better off without making someone else worse off. Security systems may have other goals, including public policy objectives, that conflict with simultaneous optimization of the criteria. The role played by risk classification in optimizing the result of a security system relative to the Pareto criterion, as well as the effect of other objectives, is discussed for short-term coverages in *Risk Classification in Life Insurance*, J. David Cummins, Barry D. Smith, R. Neil Vance and Jack L. VanDerhei, 1983: Kluwer-Nijhoff Publishing, pp. 27-62. An extension of this discussion to long-term coverages is given in “The Economics of Risk Selection,” Arnold A. Dicke, in *Genetics and Life Insurance*, Mark A. Rothstein, Editor, 2003: The MIT Press, pp.49-72.

respective participants. This description usually includes a description of the covered events, the mitigating actions (whether the payment of money or receipt of services) to be taken in case an unfavorable outcome occurs, and the price that must be paid to obtain the coverage. Most people realize that another party will not accept responsibility for a risk willingly without receiving an offsetting payment. In addition, participants usually recognize that if coverages differ in amount or in other ways, the price would be expected to reflect the differences. No one, of course, wants to be overcharged. The success of a security system thus depends on setting prices and benefits that are for the most part acceptable to the participants.

In some cases, the participants are more concerned with limitations on the risks that are covered or on the remedies that would be available under the terms of coverage to mitigate unfavorable outcomes of those risks than they are with the price of coverage. Consider, for example, a health care benefit system in which the employer pays for the coverage and the benefits are subject to little or no cost sharing. In this example, the employees may be concerned primarily with any limitations that the terms of coverage place on the conditions that are covered or on their choices of services (e.g., covered treatments) or service providers (e.g., doctors and hospitals). The price of coverage, of course, will be important to the plan sponsor.

If a system is voluntary, participation may depend on the potential participant's perception of the value received for the price and of whether differences in prices reflect differences in the value of the coverage. These perceptions, in turn, may depend on the potential participant's perception of, and aversion to, the risk that would be covered. Even in compulsory systems, the perception by participants that the prices paid are not appropriately related to the value received often will lead to dissatisfaction.

While achieving a sufficient level of acceptability is essential to the success of a security system, adopting terms of coverage that are acceptable to all participants or potential participants in all respects may not be possible. In most cases, there will be some level of dissatisfaction with the terms of coverage. In a compulsory automobile insurance system with multiple coverage providers, for example, some participants will only be able to obtain coverage from an assigned risk pool. These participants may not find the terms of coverage acceptable. An individual's willingness to pay for a specific coverage depends on many factors, including the relative value the individual places on alternative goods and services and the individual's level of risk aversion.

Even if the terms of coverage are for the most part acceptable to a potential participant, affordability may remain an issue. For coverages (such as medical insurance) that are widely considered to be essential to individual well-being, the

term *social adequacy* sometimes is used to describe the goal of a financial or personal security system that is structured to make coverage available to all or most of an at-risk group at prices that are deemed to be affordable.

3. The system will have access to sufficient resources to fulfill its promises.

The security system cannot be considered a success if, when the time comes for the system to make a payment or provide a benefit, it lacks the resources to do so. The ability to fulfill promises depends on the context of the promises, which includes the choices a participant is permitted to make about participation, level of coverage, coverage providers or other aspects of the coverage. To determine the level of resources that will be required to fulfill its promises, a financial or personal security system thus must take account of the actions its participants may take if they are permitted to make choices. In a voluntary system, the participants are permitted a wide range of choices, including non-participation. Even systems that can compel participation, however, often include elements of choice, as previously noted. The design of the security system must take account of the financial impact of all significant elements of choice if the system is to have a high likelihood of fulfilling the promises it makes.

This monograph applies to security systems for which these success criteria are recognized as necessary (although not necessarily sufficient) for the success of the system. Such systems may have other goals, including those relating to public policy, but for the system to be successful, its design must also be consistent with the achievement of a high degree of satisfaction of each of the three criteria.

SECTION II

EXPECTED COST

A. THE IMPORTANCE OF EXPECTED COST

Recall that a covered risk associated with a financial or personal security system is a risk for which the possible outcomes are the actions that would be undertaken (i.e., payments made or services provided) by the coverage provider to mitigate unfavorable outcomes associated with one or more of the system's covered events. The *expected cost of providing coverage for a covered risk* is the sum of the products of the current monetary value of each outcome of the covered risk and its associated risk probability.¹⁶

If the risk probability and the current monetary value of each outcome of a covered risk were known, the expected cost of providing coverage for the covered risk could be calculated. In most cases, neither the risk probabilities nor the current monetary value of the outcomes of a covered risk are known in advance but rather must be estimated. Risk classification, the subject of this monograph, facilitates and improves these estimates and thus any resulting estimates of the expected cost of coverage and of the cost of providing for fluctuations of the actual cost of coverage around the expected cost.

Despite the difficulties involved in such estimation, which will be explored more fully in Section III, actuaries have found the concept of expected cost to be very useful. An important consideration in the design of a financial or personal security system is the level of aggregate expected cost of coverage, not only at present, but also in the future, as can be seen in the case of “assessment societies.”

In the 19th and early 20th centuries, organizations called assessment societies adopted a simple structure intended to address the need for death benefit coverage: upon the death of a member, a specified sum was paid to his or her beneficiaries, with each living member being assessed a proportionate share of the benefit payment.¹⁷ The structure was apparently successful for a period of time, but as the members aged and as deaths and assessments became more and more frequent, applications for membership fell off and the declining pool of remaining members was saddled with ever-higher assessments.

¹⁶ Although, as discussed later in this section, provisions for fluctuation, mis-estimates of the expected cost, expenses and profit or contribution to surplus are usually necessary for the financial soundness of a security system, they are not included in the expected cost of providing coverage as the term is used in this paper.

¹⁷ Henry William Manley, “On the American Tontine and Mutual Assessment Schemes” in *Journal of the Institute of Actuaries XXVI*, London: Charles and Edwin Lawton (1887), pp. 182-218. See also, E. J. Moorhead, *Our Yesterdays: The History of the Actuarial Profession in North America, 1809—1979*, Schaumburg: Society of Actuaries (1989), pp.34-35. Not all assessment societies had the simple structure described here. In some, the level of assessment increased with age. But the expected cost of coverage over the life of participants was not taken into account. As Moorhead notes, at least one assessment society survived long enough to be converted into a life insurance company.

Eventually, the society was forced to cease operations, with the remaining members, having contributed the most funds, receiving much less than the promised death benefit.

The assessment societies were not successful security systems. Their strategy of dividing the cost of paying each benefit among the current participants appeared reasonable to the original participants. But, since the societies did not recognize the increase in the expected cost of providing coverage as the average age of the members increased, the strategy proved to be unsustainable and did not produce a viable security system. As the members aged and the annual amounts paid out in benefits increased over the years, existing assessment societies became unattractive to new members, the availability of coverage was curtailed and, in the end, the societies failed to live up to their promises.

In contrast, the 19th century also witnessed the development of a life insurance system that explicitly took account of the way expected costs of providing coverage that applied to new and existing participants differed with age. This system, of course, continues successfully to the present.

As the example of the assessment societies shows, the ability to provide for the expected cost of coverage of each participant is essential to the success of a financial or personal security system. Since covered events involve random phenomena, the actual cost of providing coverage for a large group of identical risks will fluctuate around the expected cost. The actual cost also can differ from the estimate of expected cost because of difficulties in the process of estimation.

Financial resources must be available to the system to provide for fluctuations and for uncertainty related to the process of estimation, as well as for expenses and for profit or contribution to surplus. While the cost of coverage is specific to each covered risk, these additional costs usually are not, and provisions made to cover these costs are often allocations of an amount that is needed in aggregate but cannot be assigned unambiguously to a specific covered risk. Still, these provisions are necessary for the security system to fulfill its promises. In this monograph, these additional provisions will be called *necessary additional provisions*. As will be seen in Section III, risk classification can facilitate and improve estimates of the necessary additional provisions.

B. EXPECTED COST AND THE PRICE FOR COVERAGE

The terms of coverage have been defined as a description of the rights and responsibilities of the coverage provider and its participants in a financial or personal security system. In many security systems, the terms of coverage specify that the obligation of the coverage provider to provide a specified coverage is contingent upon the receipt of certain payments. A participant's *price for coverage*¹⁸ of a risk by a security

¹⁸ The price for coverage is often referred to in insurance contexts as the "rate," "consideration" or "premium" for the coverage. In the context of pensions or other employer-sponsored benefit plans, the

system is the amount that must be paid by or on behalf of the participant in order that the participant will receive coverage for that risk under the system. The price for coverage may be paid by the participant or by another party, such as an employer, an association or a government.

In a market setting, prices are influenced by market forces such as supply and demand. If the market is regulated, as is sometimes the case for security systems, constraints may be applied to the prices that otherwise would be set by market forces. In any case, providers within a security system must determine the price at which they are willing to offer coverage.

In making this determination, providers may start by calculating the payment that would represent the expected cost of providing coverage, then increase this by a charge intended to help cover any necessary additional provisions. In this monograph, we will refer to prices set in this way as *expected-cost-related*.

The necessary additional provisions can be significant and can result in significantly different prices for coverages with the same expected cost. Catastrophe coverages, for example, may have a low expected cost, but may require payment of large claims if the covered catastrophe occurs. For such coverages, the necessary additional provision for fluctuations will be large relative to the expected cost and it would be inappropriate to set the price without reflecting this fact. Provision for fluctuation also may be required to address “contagion”—the possibility that a single covered event (e.g., a windstorm) will result in payments relative to several covered risks (e.g., a higher-than-expected number of covered structures within the area affected by the windstorm).

The necessary additional provision for uncertainty regarding the process for estimating the expected cost also can be large. This can be the case, for example, for new coverages. When long-term care insurance was introduced in the United States, claim frequencies and severities had to be estimated either from data, such as nursing home data, that either did not involve actual risk transfer or from data relating to coverages, such as Medicare, that differed in significant ways from voluntary long-term care insurance. Since data on which the estimates of risk probabilities, and therefore the estimates of expected cost, were only indirectly relevant to the covered risks, a significant additional provision was necessary.

The expected cost of providing coverage, augmented by any necessary additional provisions, is usually a critical factor in decisions made by coverage providers. It also can affect decisions made by potential participants. While potential participants considering a specific coverage no doubt focus on its possible benefits, including intangible benefits

term “price for coverage,” as used in this monograph, refers to contributions made on behalf of the participant by the plan sponsor and, in some cases, by the participant as well.

such as peace of mind, they are generally aware that a cost must be incurred to provide these benefits. Although most individuals lack the information or the ability to model explicitly the expected cost of the coverage they are considering, many observers nevertheless have noted the reluctance of potential participants to apply for coverage when the price significantly exceeds the participant's perception of the expected cost.

C. EXPECTED COST AND THE SUCCESS OF FINANCIAL OR PERSONAL SECURITY SYSTEMS

In Section I.G, the satisfaction of three criteria was identified as being necessary, if not necessarily sufficient, for the success of a financial or personal security system. These criteria tend to be satisfied by systems in which prices for coverage are related to expected cost.

1. Coverage is widely available to those in the at-risk group who desire it

If the price paid by (or the contribution made on behalf of) each participant in a system fully covers the expected cost of providing his or her coverage, together with any necessary additional provisions, coverage providers generally will be willing to offer coverage. This is true even if the cost of providing coverage is high, since the coverage provider will receive a large enough payment to offset what it estimates its cost will be. In a fully competitive system, providers will view both high-expected-cost risks and low-expected-cost risks as potential sources of profit and will have incentive to offer coverage. Similarly, in a single-provider system, if the cost of coverage and any necessary additional provisions for new participants will be covered by the contributions made by or on behalf of those participants, both high-expected-cost and low-expected-cost potential participants can be covered. Under both competitive and single-provider security systems, therefore, if prices (or contributions) are expected-cost-related, coverage will tend to be widely available to those in the at-risk group who desire it.

Achieving this result requires more than merely setting prices so that the total charged all covered risks exceeds the aggregate cost of coverage. If this condition holds but the prices for some covered risks exceed their expected costs while the prices for other covered risks are less than their expected costs, coverage providers in a voluntary system will have incentive to cover the former risks and attempt to avoid covering the latter. If the aggregate amount charged to or made available on behalf of all covered risks in a single-payer system exceeds the aggregate cost of coverage, but amounts for some covered risks exceed the expected costs and for others are less than expected cost, underestimation of the proportion of high- to low-expected cost risks can occur, leading to funding inadequacies and the need to reduce costs, often by restricting coverage. In either

case, the goal of making coverage widely available to those who desire it may not be achieved.

2. The terms of coverage, taken as a whole, are sufficiently acceptable to those eligible to be participants.

Under expected-cost-related pricing, the price-benefit comparison is likely to be acceptable to many of those making decisions about participation. Coverage that substitutes a certain payment or series of certain payments for an uncertain payment or series of uncertain payments having a similar expected value may represent an appealing proposition for risk-averse individuals as well as for decision-makers, such as employers who are attempting to offer an attractive benefit to employees. Everything else being equal, potential participants will, of course, find lower prices more attractive. But most consumers understand that the price paid must be at least sufficient to cover the cost of the good or service purchased.

For financial or personal security systems in which the difference in cost of covering risks is apparent (for example, health or casualty coverages with different deductibles or pensions that start at different ages) potential participants and other decision-makers also seem to expect a high degree of consistency between expected cost of coverage and price. Conversely, potential participants and other decision-makers are unlikely to be attracted to a security system in which prices for covering what appear to be identical risks differ significantly.

To the degree prices for coverage within a financial or personal security system are reasonably proportional to the corresponding expected costs of coverage, the system is said to achieve *individual equity*.

If the aggregate balance for each coverage provider is maintained by charging some participants more and some less than their expected costs of coverage, the pricing structure involves *internal subsidies*. For most goods and services, such inconsistency between price and cost is not well-received by consumers. In the years immediately after the end of airline rate regulation, airlines attempted to use “sophisticated” pricing algorithms that, for example, charged more for a trip from Chicago to Dallas than for a trip from Chicago to Austin with an intermediate stop at Dallas. Consumers voiced strong displeasure and the pricing structure was changed.

In some financial or personal security systems, resources in addition to payments received from participants may be available to the coverage provider from another source. Such *external subsidies* permit some or all prices for coverage to be less than the corresponding expected cost of coverage. External subsidies reduce the price of coverage and increase the attractiveness of the coverage to potential participants. The price reduction attributable to external subsidies may be reasonably proportional to expected cost, but this is not always the case.

Security systems that achieve individual equity are often perceived by participants as being “fair.” But if the expected cost for coverage of an individual participant is high—especially if this is the result of factors not under the participant’s control such as genetic conditions—some would say that a departure from individual equity is justified. “Fairness” can mean different things to different people. These issues are further discussed in Section IV.

Even when considerations of social adequacy result in prices that do not fully reflect individual equity, acceptance of the security system may be enhanced if the departure from individual equity can be demonstrated not to be arbitrary. Such is the case, for example, for Social Security benefits, in which payments to participants with lower average lifetime earnings are subsidized by reductions in payments to participants with higher lifetime earnings according to a well-defined formula.

3. The system will have access to sufficient resources to fulfill its promises.

Since the expected costs and other resources needed to provide coverage for each participant are reflected in the price paid by or on behalf of that participant, a financial or personal security system that uses expected-cost-related pricing will be more likely to be able to fulfill its promises. If, because of a desire to address social adequacy or for other reasons, a security system adopts prices that are not expected-cost-related, maintaining the financial soundness of the system may require additional risk management.

In particular, if prices do not reasonably reflect expected cost, the security system is susceptible to *adverse selection*. Adverse selection is an action¹⁹, including an action regarding participation or any element of choice, taken by a current or potential participant in a financial or personal security system that is (1) based on information not available to or not used by one or more of the coverage providers within the system but known or believed by the participant to be true and (2) perceived to confer a financial advantage on the participant.

¹⁹ The action can be either positive or negative; for example, either accepting or declining a coverage provider’s offer of coverage.

Adverse selection may result from a potential participant intentionally withholding information. It also may arise in situations in which a coverage provider is not allowed or chooses not to ask about certain conditions or facts, because the potential participant has information that is not used by the provider in deciding whether to offer coverage. Adverse selection occurs when there is asymmetry of information, whether or not the potential participant intends to deceive.

In addition, adverse selection can occur in voluntary systems or compulsory systems with elements of choice if providers depart from expected-cost-related pricing, as may be the case if material internal or external subsidies are utilized, and if this results in prices that potential participants view as low or high compared to their perception of the appropriate cost of the coverage. The potential participants use this information in deciding whether to initiate coverage at the stated price. The providers, on the other hand, by setting prices in this manner effectively have ignored some of the information they have or could have about the applicant's expected cost of coverage. Since there is asymmetry in the information that can be used by the two parties to the transaction, the result meets the definition of adverse selection.

Taking adverse selection into consideration is important in the design of voluntary financial or personal security systems. It is also an important consideration for some compulsory systems with elements of choice.

In a voluntary system or a compulsory system in which participants pay some or all of the price of coverage, adverse selection can lead to a *price spiral*—a repetitive process that occurs when an upward adjustment of prices intended to remedy a shortfall in resources leads to an exodus of risks for which the expected cost is lower than the price, and thus to a continued shortfall.

If, for a compulsory system with elements of choice, some or all of the resources needed by the system are provided by external subsidies, adverse selection can affect the system's ultimate success. If the relationship of price to expected cost varies among the available choices, participation will tend to be skewed toward the more highly subsidized choices. This can cause a phenomenon similar to a price spiral, in which the amount of external subsidy needed spirals upward beyond the level initially anticipated. If the need for external subsidy reaches a level that is not acceptable, the result may be unfulfilled promises.

The three identified criteria of a financial or personal security system—coverage that is widely available to those desiring it, sufficient acceptability to those eligible to become participants and sufficient resources to fulfill its promises—thus tend to be satisfied by a security system in which the prices for coverage offered by the coverage providers are reasonably related to expected cost of coverage and which retain this relationship even

after they are augmented by any necessary additional provisions. As a result, expected cost of coverage is of primary importance in the design of financial and personal security systems.

In designing a financial or personal security system, individual equity and social adequacy often are seen as competing objectives. If internal or external subsidies are necessary to achieve social adequacy goals, the resulting prices will be more attractive to some participants than to others. If participants in such a security system have the right to choose whether or at what level to participate in certain coverages, the system could face adverse selection, price spirals and, ultimately, the inability to fulfill its promises. Problems of this kind often can be addressed by careful design of the security system, usually starting with unsubsidized expected-cost-related pricing, introducing subsidies where needed to better address social adequacy objectives, and carefully estimating the way any elements of choice could affect financial results over time. This approach to the design of a security system facilitates identification of unnecessary or undesirable subsidies and exposes the need for decisions regarding the degree to which participant choices can be permitted and regarding the level and source of funding for those subsidies that are deemed necessary.

Understanding and quantification of the expected cost of providing coverage and any necessary additional provisions are important in the design and management of security systems having strong social adequacy objectives as well as security systems emphasizing individual equity. Estimates of the (augmented) expected cost depend on direct or indirect estimates of risk probabilities for the covered risk. Facilitation of these estimates, and thus of estimates of the expected cost, is one of the primary reasons security systems adopt risk classification.

SECTION III

RISK CLASSIFICATION

A. THE NEED FOR RISK CLASSIFICATION

Basing prices for coverage on expected costs, augmented by any necessary additional provisions, helps a financial or personal security system satisfy the three criteria cited previously as necessary for success. The coverage providers for the security system face the practical problem of how to estimate expected costs of providing coverage, as well as any of the amounts defined as necessary additional provisions in Section II.A, based on the information available to them. Both the current monetary value of the various outcomes and the risk probabilities corresponding to those outcomes may need to be estimated. Statistical methods often are used to develop such estimates, and statistical methods produce better results when observations can be made on a large group. An important step in estimating expected cost and any necessary additional provisions, therefore, is finding ways to group risks so that statistical methods can be utilized.

How coverage providers approach this challenge depends on the covered risk. Three examples of covered risk were discussed in Section I.A. The first was the risk arising from a \$100,000 life insurance policy on a 40-year old man. The risk probability for the outcome “benefit becomes payable while the man is age 60” is just the probability that the man dies at that age—i.e., the mortality rate. The severity is always \$100,000, so the risk probability only reflects the timing of the outcome. The mortality rate depends to some extent on the amount of death benefit, but risks that are the same except for relatively minor differences in the size of the death benefit (e.g., a man of the same age and in the same state of health insured at the same time, but for \$120,000) have nearly the same risk probability. In this situation, it makes sense to group together risks that are similar except for a reasonable range of variation in the benefit amount.²⁰

In the second example, the covered risk arose from a disability income policy for which the monetary loss was the payment of a fixed monthly benefit for a period of time described in the policy. The severity of this risk is the current monetary value of these payments. This means the severity depends on how long the benefit is paid. For such risks, it is usual to estimate separately the probability of the onset of disability and the probability of recovery. Separate groupings may be used for each estimate.

For the risk arising from major medical insurance, the third risk discussed in Section I.A, the risk probability reflects the probability of suffering various illnesses and injuries, as

²⁰ The mortality rate is found to vary with large changes in the death benefit amount. Thus, a risk involving a \$1 million policy usually would not be grouped with the \$100,000 and \$120,000 risks.

well as the associated severities. The monetary loss associated with providing this coverage could occur in the form of a single payment or a series of payments and the size of the payments will vary. The severity depends on when payments are made and how large the payments are. Due to the greater variety of outcomes, statistical studies can be more difficult for this risk than for other risks. In addition, it may be necessary to estimate average costs of possible outcomes directly from actual cost data.

For the examples just discussed, it might be sufficient to estimate the mean of the risk probabilities (e.g., the mortality rate in the case of the life insurance policy). For other coverages, more information about the risk probabilities may be required. Examples were given in Section II.B of coverages for which the provision for fluctuations of the actual cost of coverage around the expected cost is significant. To estimate this provision, knowledge of the mean of the distribution of risk probabilities would be insufficient. Additional information, such as the variance of the distribution, would be required.

These examples indicate that the challenge of estimating the risk probabilities takes many forms and that no single solution applies to the problem in all its forms. Statistical methods can be applied if risks that have substantially similar risk probabilities can be grouped and their outcomes observed over time.

Risk classification is a process by which such grouping is accomplished. This section will describe the aspects of the risk classification process that commonly are used in financial or personal security systems. Adapting this process to specific risks faces many practical issues and often requires professional judgment to accomplish.

A *risk class* is a set of covered risks grouped together by a coverage provider based on its knowledge or belief that some or all of the risk probabilities of the possible outcomes associated with each risk in the class are substantially similar. The risk probabilities often are estimated by observing the incidence and severity of covered events that actually occur for the covered risks in the risk class. As long as the risk probabilities remain stable over a given time frame, such historical data may provide a basis from which a reasonable estimate of the risk probabilities for the risks in the risk class can be derived. When these conditions do not hold, other approaches can be used, as will be discussed in subsection E below.

To utilize risk classification a method must be established for deciding how to assign each risk to a risk class. A system that accomplishes this goal by specifying a set of risk classes, together with a procedure that is used to assign each covered risk to one of the risk classes, is called a *risk classification system*.

B. RISK CHARACTERISTICS

Risk classification typically involves the identification of certain characteristics of the risk subject associated with the risk. Recall that a risk subject has been defined as a person or thing, or a collection of persons or things, associated with a risk. For many risks it is possible to observe qualities—often, but not always, quantitative in nature—associated with the risk subject or subjects that provide useful information about the likelihood of the various outcomes associated with the risk. Age, for example, is a quality associated with a person that provides useful information about the risk of his or her death within the next year. Not every quality associated with a risk subject provides such useful information. For example, the solidity of construction of a car and the health of a person might provide useful information about the risks involved in collision coverage. Similarly, the health of a person might provide useful information about the risks involved in life insurance coverage. But, under most circumstances, the color of the car’s upholstery is not an indicator of the likelihood or severity of a collision and the color of a person’s eyes is not an indicator of longevity. Observable qualities of the risk subjects that do provide useful information about the risk probabilities associated with the risk are called *risk characteristics*.

The “useful information” provided by risk characteristics often will emerge from an examination of historical data. However, even if historical data are limited or unavailable, risk characteristics are often useful in grouping together risks with substantially similar risk probabilities²¹.

For a given risk, there is often more than one risk characteristic that provides such useful information. For the risk faced by the sponsor of a pension plan, for example, the risk characteristics of a given retiree might include the age, gender and health of the recipient, among other factors. Some of these may be of limited use in estimating the expected cost of the pension program. On the other hand, some relevant risk characteristics—the cholesterol level of the retiree, for example—may not be available to the estimator. For automobile insurance, both the principal driver and the vehicle could be risk subjects. Relevant risk characteristics of the principal driver may include driving experience, driving record and geographic location of principal residence. The insured vehicle also has risk characteristics associated with the insurance coverage, such as vehicle type and other particulars.

The ways risk characteristics are used in a risk classification system vary. A value often is determined for each risk characteristic and the set of these values determines the risk class to which the risk is assigned. For example, the life insurance risks for all male age 45 non-smokers with diastolic blood pressure readings below 90 and no significant

²¹In the remainder of this monograph “similar risk probabilities” will be used instead of the more explicit “similar risk probabilities of the associated possible outcomes.”

differences with respect to other risk characteristics might be assigned to the same risk class.

For some risk characteristics, such as age, determining a value is straightforward and objective. For others, determining a value might require a degree of judgment. Examples for which judgment may be required include assigning a value to represent the seriousness of some medical conditions considered in connection with an application for life insurance coverage and assigning a value to represent the composition of a building being considered for fire coverage.

There are situations in which several distinct risk classes turn out to have similar estimated risk probabilities. In such a case, the risk classes can be combined. Life insurers often employ a system in which point ratings are assigned to various impairments to health and all risks with total scores within specified ranges are assigned to the same risk class. For this system to work, the point rating for each impairment must be chosen carefully. Also, simply adding point scores for several impairments may not work if the impairments are not independent of one another. In such cases, adjustments reflecting correlations might need to be made. Personal automobile and homeowners insurance usually employ similar systems in which, for example, many diverse geographic rating territories are identified. These territories may differ with respect to population density and distance to fire departments and hospitals, as well as other factors, but territories with similar values for a set of risk characteristics nevertheless could be grouped together.

Not all risks with similar estimated risk probabilities need to be grouped together. Life insurers, for example might place the mortality risks associated with male non-smokers of a given age and those associated with female smokers of the same age in separate risk classes—even though the observed mortality rates are similar at many ages. Several factors could account for this: the equality may not hold at all ages, the rates may have to be displayed separately, or the equality may not be expected to continue to hold over time.

C. NUMBER OF RISK CLASSES, ADVERSE SELECTION AND INDIVIDUAL EQUITY

In the process of designing a risk classification system, the selection of the number of risk classes to use is pivotal. There are certain advantages in having a smaller number of large risk classes, while other advantages may accrue from having a larger number of small risk classes. Fewer risk classes allow for a greater volume of observed data to be used in

estimating the risk probabilities of each risk class. A greater volume of data tends to increase confidence in the estimates.²²

But if the number of risk classes is small, some risk classes could turn out to be insufficiently homogeneous—the range of variation of the risk probabilities within the risk class may be too great. Risk classes that are insufficiently homogeneous may be subject to a form of adverse selection that results in underrepresentation within each class of those risks having relatively favorable risk probabilities. The effect can be significant if the variation in risk probabilities is large. In a competitive market, adverse selection could affect a coverage provider with risk classes that are insufficiently homogeneous when compared to those of its competitors. There were life insurance companies, for example, that experienced a significant level of adverse selection when they continued to offer the same rates to smokers and non-smokers after most of their competitors had begun offering lower rates to non-smokers. Adverse selection can also occur, even in a single-provider system, when a risk class is so inhomogeneous that some potential participants choose to forego coverage altogether. For example, health plans that are required to use “community-rating” (i.e., to place all risks in the same risk class and charge the same price for identical coverage regardless of age or current health) often have difficulty enrolling young persons currently in good health.

Thus, the selected number of risk classes reflects a balance between the desire to minimize adverse selection and the desire to maximize the volume of historical data available for each risk class. Other factors, such as simplicity of implementation, also may affect this decision.

When risk classes can be made more homogeneous, prices based on these risk classes will exhibit a greater degree of individual equity. The use of risk classes that are insufficiently homogeneous, on the other hand, can have the result, intended or not, that some participants within a risk class subsidize others within that class. If the effect is too pronounced, the perceived reduction in individual equity can make the coverage less acceptable to many participants and to many who are eligible to become participants.

In some cases, a coverage provider may be constrained in its choice of risk characteristics, either by law or by other factors. Such constraints in most cases result in fewer risk classes that are each less homogeneous. In voluntary financial or personal security systems and in compulsory systems with elements of choice, constraining provider choice of risk characteristics and thus decreasing the degree of individual equity may increase the likelihood that providers will experience adverse selection.

²² A commonly used measure of the reliability of data is the *credibility* of the data relative to some standard. Credibility is a measure of the predictive value attached to a particular body of data relative to some other body of data. A credibility-based estimate is a blend of a provider’s experience data with some standard, such as system-wide experience. The weight given to the provider’s experience data increases as its credibility increases.

Considerations of this kind are critical to the design and implementation of successful risk classification systems. These considerations will be discussed in detail in Section IV.

In competitive security systems, refining the risk classification system²³ has been observed to reduce the average price of coverage. When term life insurance “standard” risk classes were separated into “preferred” and “residual preferred” risk classes, the prices for the preferred classes were reduced significantly, but the prices for the residual standard classes were not increased comparably. In many cases, the increase was negligible. Since a provider in a competitive security system offering rates based on the original standard risk classes could not know what mixture of “preferred” and “residual standard” risks it would attract, prudence required basing the price for each risk class on a conservative estimate of the mixture within that class. When the division is made into preferred and residual standard classes, this uncertainty is removed²⁴ and prices charged members of each new risk class are closer to the estimated cost of coverage for that risk than was the case before refinement. In a competitive security system, refinement of the risk classification system thus can result in a reduction in the average amount by which the price exceeds the expected cost of coverage. In addition, because the range of variation of the risk probabilities within each class is smaller, refinement of the risk classification system also can reduce the adverse selection experienced by the security system.

D. DYNAMIC ASPECTS OF RISK CLASSIFICATION

Risks are dynamic: they can and do change over time. Because the risk probabilities for a given risk can and do change, the expected cost is likely to change as well. Aging of the risk subject, for example, often results in changes in the associated risk. The probabilities of disability and death generally increase with age in human beings; similarly, the probability of malfunction usually increases with the age of vehicles and machinery. For this reason, age is frequently a risk characteristic used in defining risk classes. The change in risk probabilities with age, however, is not the same for all covered risks. In any group of covered life insurance risks with initially identical risk probabilities, for example, some will experience health problems while others will not. In such cases, the risk probabilities will diverge with time due to differential experience among the covered risks.

²³ A *refinement of a risk classification system* is a risk classification system obtained by dividing one or more of the original risk classes. This may occur when a new risk characteristic, such as smoker status, is introduced.

²⁴ The reduction in price is due to the reduction in the provision for uncertainty in the basis used to estimate expected cost that results from increased homogeneity within risk classes. Repeating the process of refinement will have progressively less pricing impact; moreover, the process is limited by the need to have risk classes large enough to permit reliable estimates to be made from the data generated by the risks in the class.

Even the risk probabilities associated with a specific set of risk characteristics may change over time. The mortality rates for 40 year old non-smoking women in good health, for example, have tended to improve over time. This improvement is due to improved medical care and other causes related to the environment that exists at the date of observation. Thus, in addition to the age of the risk subject and the time since initial classification of the risk, the risk probabilities may depend on the calendar date.

The dynamic nature of risks has important implications for the design of a risk classification system. Since changes in the risk probabilities rarely will be exactly the same for any two risks, the expected costs for risks arising from identical or nearly identical coverage in a given risk class usually will diverge over time, even if the risks initially have similar values for all relevant risk characteristics. In the example just discussed, the risk characteristics for a group of newly-underwritten applicants for life insurance might be very similar, but as time passes some of those accepted for coverage will experience disease or other impairment while others will not. As a result, the variation in the expected costs of future coverage among risks associated with identical or nearly identical coverage and assigned to the same risk class at time of underwriting increases as the time since underwriting lengthens.

When the risk subject is a group—for example, a group of employees—associated risks might change due to change in the composition of the group. The risk associated with a company’s workers’ compensation coverage, for example, can be changed significantly by the hiring of a significant number of new workers who are not, as a group, as proficient with tools nor as risk-averse as are the more experienced workers.

Changes in the value of any risk characteristic can have an effect on estimated risk probabilities. For example, for many risks associated with manufacturing, the existence of an effective employee safety program is an important risk characteristic. The resignation of the employee responsible for the employee safety program could reduce the effectiveness of the program and consequently require a change in the estimate of the risk probabilities.

The relationship of any set of risk characteristics to the risk probabilities for a given risk also may change over time. For example, the presence of a serious disease is a frequently used risk characteristic for life insurance coverages. The advent of new therapies can change the implications of such risk characteristics. An example is the advent of therapies utilizing multiple drugs (drug “cocktails”) that resulted in dramatic increases in the longevity of persons infected with the HIV virus.

Similarly, if a new method of risk reduction is developed, evidence regarding the status of its implementation can be a risk characteristic. As an example, consider a house located within an area subject to hurricanes. The location of the house in a hurricane area is, of course, an important risk characteristic for property insurance. It has been found

that specially designed roofs can cause a significant change in the probability of severe damage from windstorms. Introducing the presence or absence of such modifications as a new risk characteristic for houses subject to hurricanes likely will improve the risk classification system by placing such houses into risk classes that have more appropriate and more stable expected costs of coverage.

If the relationship of risk characteristics to the risk probabilities associated with a risk changes over time or if new risk characteristics become available, a different set of risk characteristics or a different weighting of existing and new risk characteristics may result in a more appropriate set of risk classes. The introduction of nicotine-use status²⁵ as a risk characteristic for life insurance is an example. Another example is the separation of the “ob/gyn” risk class for medical malpractice insurance into “gynecology (without obstetrics)” and “obstetrics” risk classes. If a change in classification is introduced simultaneously for all coverage providers, participants for whom a more favorable price becomes available may be expected to replace their coverage. If, as was the case with the introduction of nicotine-use status, new coverage can be obtained without significant effort, replacements by those participants able to qualify for more favorable prices are likely to occur quickly. If, as was the case for the medical malpractice example, replacement requires significant effort (in the example, change in licensing status), the replacements will occur more slowly, perhaps taking decades.

As long as the coverage providers are able to make appropriate changes in risk classes and prices, the system can stabilize, although the replacement cycle may be costly for providers of long-term coverages. If, however, a coverage provider is unable to make appropriate changes to its risk classes, and if in addition participants have the right to choose between or change coverage providers or to make changes regarding the terms of coverage, adverse selection may result. Even if the coverage provider has the right to increase the price of coverage, it could be difficult to avoid losses. Attempts to increase the price of coverage applicable to an insufficiently homogeneous risk class can lead to a price spiral—the price increase causing an exodus of more favorable risks that leads to another price increase, causing a further exodus.

Whether changes to the risk classes can be made, and if so whether the new risk classification can be applied only to new participants or to both new and current participants, depends on the terms of coverage which in turn could depend on laws and regulations, market positioning, business practices and other considerations. This will be discussed further in Section IV.

²⁵ Several definitions of nicotine-use status are in use in the U.S. life insurance industry currently. The status “non-smoker” may refer to those who have not smoked cigarettes or cigars for some period of time, such as one or two years. The status “non-tobacco-user” may refer to those who have not used tobacco in any form for some period of time. Other definitions are also used.

E. RISK CLASSIFICATION AND THE ESTIMATION OF EXPECTED COST

As explained above, estimates of the risk probabilities for a group of risks may be based on historical data regarding frequency of occurrence and severity observed for those risks, provided the risks are substantially similar to one another. When an effective risk classification system is in place, the coverage provider can study historical data to estimate risk probabilities for each risk class and thus the expected costs for the risks in the class. This approach to estimating expected cost is used for many common coverages. When conditions are stable over time and when risk classes are sufficiently homogeneous and are expected to remain so, reliable estimates of the risk probabilities and thus of the expected cost of coverage can be based on historical data.

The relevance of data obtained from historical studies might be limited if the conditions under which the data were observed or the observed mix of risks are not those that are expected to apply to the risk probabilities being estimated. Historical information can lose relevance quickly as economic and social environments and other factors change.

If appropriate risk classes have been established but historical data for a class are either insufficient or no longer relevant, reasonable estimates of risk probabilities can be based on other sources. Historical data obtained by others for similar risks, particularly in cases in which a similar risk classification system was in use, are usually the alternative sought first because this source may provide the most relevant data available.

Relevant data also can be obtained from studies of a single risk characteristic. To apply the data obtained in such studies to the estimation of risk probabilities, additional analysis reflecting the interaction with other risk characteristics may be required. Hurricane and earthquake models used in connection with property insurance take account of the combined impact of many risk characteristics. When supplemented by specific information about a property, such as details about construction of roofs, walls, etc., such models can assist in the classification of the risks inherent in providing such coverage.

In the absence of relevant data from any source, the judgment of a professional, such as an actuary, may be the only means to obtain an estimate. The application of judgment is subject to professional standards that are intended to enhance consistency and reliability of the estimates. Such standards may require that assumptions regarding risk probabilities be consistent with any available data, taking into account known or anticipated differences between the current risk in its environments and the risks and environments that led to the available data. Such standards also may require disclosure of any limitations that could affect the effectiveness of the risk classification system and any other caveats that are deemed to be relevant. Members of the American Academy of Actuaries who render advice on risk classification are subject to a specific standard, Actuarial Standard of Practice No. 12, *Risk Classification* (for All Practice Areas), and also must meet applicable qualification standards.

Whatever method is used to develop estimates of risk probabilities and thus of expected costs of coverage, the use of a risk classification system will promote internal consistency of the estimates, decrease the likelihood of adverse selection and facilitate the tracking of data going forward.

F. RISK CLASSIFICATION AND THE SUCCESS OF FINANCIAL OR PERSONAL SECURITY SYSTEMS

An effective risk classification system helps a financial or personal security system to meet the three criteria the satisfaction of which was previously cited as necessary, though not necessarily sufficient, for success.

1. Coverage is *widely available* to those in the at-risk group who desire it.

In a competitive system, the use of risk classification systems enhances the accuracy of estimates of the expected cost of providing specific coverages and of fluctuations in the expected cost, and thus allows potential coverage providers to make better informed choices about whether to offer those coverages. Risk classification systems, therefore, promote more competition, with numerous coverage providers, each making its own decisions. In such a market, even an individual with unusual risk characteristics is more likely to find at least one coverage provider—often several—willing to offer coverage. With an effective risk classification system, a single-payer system is similarly better able to estimate the costs of providing various proposed coverages and the impact of proposed elements of choice and to optimize the impact of any external subsidies on availability and affordability.

2. The terms of coverage, taken as a whole, are *sufficiently acceptable* to those eligible to be participants.

Risk classification facilitates expected-cost-related pricing and thus promotes individual equity. Individual equity is innately well-understood and generally well-received by potential participants, since it tends to align price with perceived value and to produce sets of prices the relationship among which is perceived as reasonable. Where social adequacy considerations result in a departure from strict individual equity, the ability to demonstrate that the departure is not arbitrary can enhance acceptance of the system. In competitive systems, risk classification allows providers to price with less uncertainty and thus leads to a reduction in the amount by which the price exceeds the expected cost. In these ways, risk classification can increase the acceptability of the terms of coverage, taken as a whole, to those eligible to participate in the system.

3. The system will have access to *sufficient resources* to fulfill its promises.

By grouping together risks into relatively homogeneous classes, the risk classification system reduces the adverse selection that occurs when high-risk and low-risk participants are offered identical coverage at the same price. In addition, risk classification facilitates the estimation of the expected cost of coverage (and fluctuations in the expected cost) and in this way increases understanding of the level of financial resources needed to fulfill the security system's promises. In these ways, an effective risk classification system increases the likelihood that the financial or personal security system will fulfill its promises.

As this discussion shows, the degree to which each of the three criteria is satisfied can be significantly enhanced by utilization of a well-designed risk classification system.

SECTION IV

CONSIDERATIONS IN DESIGNING AND MANAGING A RISK CLASSIFICATION SYSTEM

Financial or personal security systems exist to mitigate risks faced by individuals. In order to achieve this purpose, a security system must continue to exist and to provide benefits over an extended period of time. No matter how good the intentions when the security system was put into place, if it fails to deliver on its promises, much harm can be done.

In order to satisfy the three success criteria discussed above, a security system must be carefully designed. Design flaws that seem insignificant at first can become unmanageable over time. In addition, the design must be reviewed periodically and necessary changes made to respond to the inevitable changes in the circumstances in which the security system operates. This is true for voluntary and compulsory systems and for competitive and single-payer systems. Inappropriate design has doomed to failure both small privately-run systems and large government-sponsored systems.

Careful design of a security system requires careful design of its risk classification system. This section sets forth some of the factors that typically are considered when a risk classification system is designed and when that design is reviewed as conditions change and experience accumulates. Actuaries often are called on to provide advice regarding the design of risk classification systems. Actuarial Standard of Practice No. 12, *Risk Classification (for All Practice Areas)*, was published to give guidance to actuaries involved in this activity. Brief quotations from this standard will be used where appropriate.

A. PURPOSE OF RISK CLASSIFICATION SYSTEM

Security systems utilize risk classification in several ways. As discussed in Section III, risk classification facilitates estimation of expected costs of coverage. It therefore can be useful for setting prices and for determining the desirability of offering coverage at a given price. In addition, the use of risk classification can help in obtaining accurate assessments of the magnitude of the obligations that are incurred by the coverage provider. The uses of risk classification vary by the type of security system and the system's goals.

1. Type of Security System

Financial or personal security systems are established to provide for advance transfer of risk for members of an at-risk group. Individuals face many kinds of

risk. As a result, there are many types of coverage offered by security systems, including life, health, property and casualty insurance and pensions and other longevity risk programs. Each type of coverage could be offered by a voluntary or a compulsory system. The system could provide for competition among a number of coverage providers or could have a single provider.

Risk classification can be useful in each of these contexts. As might be expected, the design of the risk classification system will be adapted to fit the context. To establish a risk classification system, it is necessary to establish risk classes and to maintain the risk classification structure over time. Both the establishment and the maintenance of the risk classification system depend on the type of security system and the system's goals. The system's goals are often affected by organizational, social and legal considerations.

2. Functions Supported by the Risk Classification System

As discussed in Section III, risk classification can play an important role in helping security systems achieve success both through promoting individual equity and through controlling adverse selection. In addition, risk classification assists several functions that may be required by the security system.

Pricing is based on assumptions regarding risk probabilities. Experience studies to determine appropriate assumptions are also based on data that is grouped and analyzed by risk class. While these are often the same risk classes as in the pricing structure, this need not be the case.

Risk classes also are used for setting liabilities for financial reporting purposes and for risk management analysis. Liabilities include obligations for mitigating the outcomes of future covered events and obligations for mitigating outcomes of covered events that already have occurred. While the risk classes used in the pricing structure of the security system might be used for this purpose, the use of more or less refined risk classifications for financial reporting and risk management may be appropriate. If legal or business considerations result in the use of a less refined risk classification system than could be supported by the volume of experience data, for example, using more refined risk classes for risk management could be prudent.

In some cases, the risk classification system set up for one function is useful in reviewing the results of a risk classification system set up for a different purpose. If unisex prices are mandated, for example, a risk analysis based on gender-distinct risk classes could be useful in managing the security system to ensure financial soundness.

B. ORGANIZATIONAL CONSIDERATIONS

The design of a risk classification system will be influenced by the type of coverage provided by the security system, the way the coverage is marketed and paid for and the organizational structures necessary to initiate and administer it.

1. Who Pays for Coverage

The pricing structure and thus the risk classification process can be different for a security system in which the price for coverage is paid by individuals than for a system in which an employer or other entity pays all or some of the price for coverage for a group of participants. If the price is paid by an employer or plan sponsor or by a governmental agency, the individual participant may not be aware of or, if aware of, may be indifferent to the risk classification process used by the coverage provider. In this case, it is possible that less detailed classification systems might be sufficient. To the extent participants have choice about benefits, participation or contribution levels, however, adverse selection can become a problem. To the extent participants become aware of departures from individual equity, dissatisfaction could surface.

2. Underwriting and Risk Selection

In voluntary systems, detailed risk classification frequently is implemented through an underwriting process. Underwriting involves the assignment of an individual risk to a risk class based its specific attributes. Some of these attributes can be determined readily. Examples include age and gender of the proposed insured for life and health coverages and pensions, and age and make of vehicle for automobile coverages. Other attributes (for example, cholesterol levels and driving records) are gathered by testing or other means. In some cases, knowledge of these attributes alone may enable assignment to a risk class. In some cases, however, the accumulated information regarding the risk is evaluated by a qualified professional. Input of this kind often is sought for the evaluation of unusual risks or risks that cannot be assigned to a risk class based on the accumulated information alone. If an underwriting process provides for the input of professional underwriters, the risk classification system is better able to incorporate a wider perspective than otherwise would be the case.

In most cases, employer-sponsored programs including pension plans do not require underwriting of individual employees. But in cases in which the amount of coverage on one or more individuals greatly exceeds the average, underwriting of such individuals could be required.

While underwriting is used commonly in connection with life insurance, it is applied much less frequently in the case of annuities that make periodic payments. This is consistent with a belief that it is more difficult to determine how much healthier than average a potential participant is, as compared to determining how much less healthy.

If coverage providers in a voluntary system or a compulsory system with elements of choice are not permitted to, or do not elect to, assign risks to appropriate risk classes, they could be subject to significant adverse selection. Coverage providers in voluntary systems that find themselves facing such adverse selection in a given market have an incentive to exit the market or to discourage the acquisition of new participants. Coverage providers in compulsory systems with elements of choice faced with such adverse selection might take action to discourage participation. These situations will be discussed further in Subsection E below.

3. Marketing and Enrollment

Individuals face many risks, but, in some cases, are not fully aware of those risks or of how particular forms of coverage provided by a security system could address them. In such situations, the system's coverage providers may develop marketing programs. The approach to marketing taken by the coverage providers can have implications for risk classification. For example, when a direct marketing approach, such as television advertising with a call-in number or a web site, is used, the ability to carry out rigorous underwriting is limited. Simpler risk classification approaches are usually used in such situations.

In a voluntary system, after a coverage provider establishes a set of risk classes and the corresponding price for coverage, competition in the market determines the provider's "mix of business"; that is, the distribution of risks among the provider's risk classes. A coverage provider's marketing program has an important influence on its mix of business. Arbitrary restrictions on the marketing program could produce unintended changes in the mix of business and affect the financial soundness of the system.

Employer-sponsored programs normally do not require marketing to the employees. But if participation is non-compulsory, enrollment procedures may have a "marketing-like" component.

4. Industry Practice

In designing a risk classification system in a competitive system, it may be prudent to take industry practice into account. If a coverage provider establishes a risk classification system that is a refinement of a competitor's, the resulting price

differentials can cause an exodus from the competitor resulting in significant adverse selection. This indeed occurred when the smoker/non-smoker distinction was introduced into life insurance underwriting.

Industry practice regarding the treatment of certain risks may differ from the treatment indicated by available data. For example, the mortality rate in the first year of life, particularly the first few months of life, is greater than the mortality rate in the second year of life. Despite this fact, a common life insurance industry practice is to charge a rate for coverage in the first year of life that is not greater than the rate charged for coverage in the second year of life. In some cases, this is compensated for by reducing the benefits during the first policy year for policies issued during the first year of life. Industry practice also can affect underwriting and risk selection. A “self-insured” association for workers’ compensation insurance, for example, may determine that all but the worst risks applying for coverage should be accepted.

In many cases, the effect of these practices can be determined only by comparing the risk classification structure that would be appropriate in their absence with the probable effect of the risk classification system that results from their presence. Actuarial Standard of Practice No. 12 contains guidance on this subject, including guidance on disclosure.

Industry practice has less impact on employer-sponsored security systems. Labeling certain occupations as “blue-collar” as opposed to “white-collar” is one example, however, in which industry practice does play a role.

C. ESTABLISHMENT OF RISK CLASSES

Risk classes are collections of risks that the coverage provider knows or believes to have similar risk probabilities.

1. Identification of Risk Characteristics

Most coverage providers utilize risk characteristics to facilitate the assignment of risks to risk classes. In some cases, the coverage provider can select a set of risk characteristics such that knowing the values of these risk characteristics for a given risk subject is enough to allow the coverage provider to assign the risk to an appropriate risk class. In other cases, however, the information provided by risk characteristics is interpreted by a qualified professional before the risk is assigned to a risk class. In any case, the purpose of risk characteristics is to allow the coverage provider to discern relationships that exist between the available information and the risk probabilities of a risk class. Certain aspects of risk characteristics have been found to be desirable for achieving this purpose.

a. Objective determinability

It is usually desirable that a risk characteristic be objective and measurable and that potential participants cannot easily manipulate or control the value of the characteristic.

According to Actuarial Standard of Practice No. 12, “a risk characteristic is objectively determinable if it is based on readily verifiable observable facts that cannot be easily manipulated.”²⁶ On this basis, “blindness” is not objectively determined, since people with some residual vision may be reported as being blind, whereas “vision corrected to no better than 20/100” is objectively determined.

Many objective characteristics are measurable: age, cholesterol level, number of DUI convictions are examples. The measure can be intrinsic to the risk characteristic, as in the examples just given. In other cases, a measure can be assigned. Binary characteristics, such as gender may be thought of as assigning values such as 1 and 2 to the two outcomes and thus are measurable.

In an effective risk classification system, the risk characteristics usually are susceptible to convenient and reliable measurement and almost always are objectively determinable. Moral character and driving pattern are examples of characteristics that usually are not objectively determinable.

b. Controllability

A coverage provider is likely to be reluctant to rely on a characteristic that can be controlled by a potential participant. In fact, such a characteristic does not provide useful information concerning risk probabilities and therefore is not a risk characteristic, as defined in this paper. In some situations, however, a coverage provider may wish to recognize peril reduction efforts or may believe that using such a characteristic will increase the public acceptability of the coverage. Although these reasons may be valid, the result can be adverse selection.

A health insurer, for example, might consider using “membership in an exercise facility” as a risk characteristic in an attempt to promote healthy behavior. This characteristic clearly is controllable by the participant. Since the amount of exercise that the participant actually intends to undertake is known to the participant but not the health insurer, adverse selection could occur. A risk characteristic based on actual records of past attendance or, even better, of change in body build measurements would be less controllable and

²⁶ Actuarial Standard of Practice No. 12, paragraph 3.2.3

less susceptible to adverse selection.

Controllability of a potential risk characteristic should be distinguished from controllability of the risk itself. In the example just discussed, if the participant actually adopts a healthy life style, the risk itself will be reduced. The problem for the health insurer is to find potential risk characteristics that cannot be manipulated easily and that can help the insurer determine whether a particular participant actually has adopted a healthy life style.

Even if a quality is controllable, it could serve as a risk characteristic when used in conjunction with other risk characteristics. An example is the “smoking or use of tobacco” risk characteristic used in life and health insurance. For larger policies, insurers augment a question about tobacco use in the last year or two years with an estimate of level of use ascertained by use of a urine sample. The urine sample alone can be manipulated: quitting for a few days can cause a negative sample. But used in conjunction with a question on an applications (and the possibility of rescission upon the discovery of misrepresentation), the smoking status risk characteristic has proven to be effective.

Controlling a risk characteristic sometimes implies controlling the risk itself to a greater or lesser degree. Controlling obesity, for example, contributes to controlling mortality and health risks. Controlling the number of moving violations controls the risk of automobile accidents. Some coverage providers have perceived an advantage in the use of such risk characteristics due to their acceptability to potential participants and the general public. This acceptability may arise from a view that risk classification is a form of “grading,” in which “good” behavior of the risk subject is awarded and “bad” behavior penalized. This is not, of course, the intention of coverage providers in establishing a risk classification system. Rather, risk classification is intended to facilitate accurate estimates of risk probabilities and expected costs of coverage.

c. Avoidance of Overly Large Discontinuities

Many risk characteristics have values that vary continuously across a range. This is the case, for example, for amount of coverage, age, blood pressure, salary and many other risk characteristics. In forming risk classes using such continuous risk characteristics, the range of values for each characteristic is usually segmented. The risk characteristic age, for example, may be segmented into one year intervals around each integer age: 49-1/2 to 50-1/2, etc. Since different risk probabilities are assigned to each of the risk classes, certain very small changes in the value of the risk characteristic (in our

example, the change from age 50 years and 182 days to 50 years and 183 days) result in noticeable “jumps” or discontinuities in the risk probabilities. To avoid overly large discontinuities, the segment size usually is made as small as possible (for example, grouping life insurance risks by “under 65” and “over 65” would lead to discontinuities that would be considered unacceptable).

If discontinuities caused by overly extensive segments are avoided, just how the segmentation is accomplished usually does not have a significant impact on the effectiveness of the risk classification system. This is because small changes in the values of a risk characteristic usually imply small changes in the associated risk probabilities, and thus small changes in estimates of expected cost of coverage. The expected cost of life insurance for an insured age 60 years, one month, for example, will differ by only a small amount from the expected cost for the same life insurance on an insured age 60 years, two months. In such cases, however the range of values is divided, provided the segments are not too large, the risks within each risk class will have substantially similar risk probabilities.

On the other hand, for some continuous risk characteristics, a small difference in the value of the risk characteristic corresponds to a large change in the risk probabilities and thus of the expected cost of coverage for otherwise identical risks. If a river is confined within steep ridges, for example, the expected cost of flood insurance coverage for a house on the top of the ridge may be significantly lower than for a house at the bottom of the ridge. The distance from the river bank might be a useful risk characteristic for houses below the ridge—providing a reasonable way to assign them to risk classes—but a coverage provider would not want to put the house on top of the ridge into the same risk class as nearby houses below the ridge.

Note that, had elevation above river bank level been chosen as a risk characteristic instead of distance from river, discontinuity would not have been a problem. Avoiding overly large discontinuities is essential to the design of an effective risk classification system. In some cases this can be accomplished by changing the risk characteristic.

d. Correlation and Causality

A risk characteristic of a risk subject associated with a risk has been defined as an observable quality of the risk subject that gives useful information about the likelihood of the occurrence or about the severity of the outcomes associated with the risk. This definition is quite broad and there are many ways—ranging from credible statistical studies to informed professional

judgment—of establishing that a specific quality of a risk subject is a risk characteristic. If statistical studies are not available, a perceived relationship between a quality and a risk probability is often sufficient to establish that the quality is a risk characteristic. Heavy smoking, for example, was observed to be related to increased mortality and morbidity long before credible statistical studies of the correlation became available. Over time, observation of actual results can be examined to confirm or modify the initially perceived relationship.

In cases in which a specific quality of the risk subject can be shown to be correlated to a risk probability, the quality provides sufficient useful information for it to be used as a risk characteristic. Studies of correlations are important contributors to our understanding of both natural science and the social sciences, including economics. When a correlation persists through repeated studies, there is a strong likelihood that the occurrence of one of the correlated factors will indicate the presence of the other factor. If one of the correlated factors normally precedes the other, it is reasonable to use the earlier factor as a predictor of the later factor.

The existence of a persistent correlation often prompts a search for an explanation that usually takes the form “A causes B.” In natural science, such an explanation is called a “theory.” A scientific theory is always adopted tentatively, subject to verification²⁷ and replacement by a more robust theory.

A cause-and-effect explanation sometimes is readily apparent as, for example, is the case for the correlation of a prior heart attack with shortened longevity. In other cases, although a statistical correlation is well-established, a cause-and-effect explanation for the correlation is not. A striking example is the relationship between smoking and lung cancer. The statistical relationship between smoking and lung cancer was described in the Hammond-Horn study of 1954.²⁸ Based on such statistical evidence, in 1964 the Advisory Committee to the Surgeon General released a report stating, “The array of information from the prospective and retrospective studies smokers and non-smokers clearly establishes an association between cigarette smoking and substantially higher death rates.”²⁹ Many people stopped smoking and eventually some life and health insurers started charging different prices for smokers and non-smokers. Despite the establishment of strong correlation between smoking and increased mortality, a full description of the physical

²⁷ Or, more precisely, “falsification,” the repeated attempt to discover situations not predicted by the theory.

²⁸ Hammond, E. C., and Horn, D., *Relationship Between Smoking Habits and Death Rates: Follow-up Study of 187,766 Men*, J. A. M. A. 155, Aug. 7, 1954, pp 1316-1328

²⁹ “Smoking and Health: Report of the Advisory Committee to the Surgeon General of the Public Health Service,”(1964)

mechanism—the “cause-and-effect explanation”—was long in coming. As noted in 1999 by Hecht,³⁰ “Extensive prospective epidemiologic data clearly establish cigarette smoking as the major cause of lung cancer,” but “Even in the writings of distinguished scientists with great expertise in cancer causes and mechanisms, one can read statements such as “The carcinogenic mechanisms of tobacco smoking are not well understood.” The 2004 Surgeon General’s report gives a detailed discussion of the difficulty in establishing a causal relationship through the use of statistical studies and states, “When there is a still incompletely understood pathogenic mechanism, the causal claim might still be justified by very strong, direct empirical evidence of higher rates in smokers (i.e., strong, consistent associations).”³¹ In this case, although all the details of the physical mechanisms that explain the relationship between smoking and increased mortality and morbidity—the cause-and-effect explanations—are still not available, the existence of well-established correlations, augmented by the professional judgment of the researchers, has resulted in widespread public acceptance of the smoker/non-smoker binary risk characteristic.

In addressing this issue, Actuarial Standard of Practice No. 12 states, “While the actuary should select risk characteristics that are related to expected outcomes, it is not necessary for the actuary to establish a cause and effect relationship between the risk characteristic and expected outcome in order to use a specific risk characteristic.”³²

In some cases, the use of a risk characteristic that exhibits a strong correlation to the outcomes of a covered risk, but for which no cause-and-effect explanation has been established, may be unfavorably received by the public. There is a considerable body of information, for example, indicating that credit rating is a meaningful risk characteristic for automobile insurance.³³ But there has been some public resistance to use of this risk characteristic. Even if it is accepted that the correlation holds, specific cases may be cited for which the resulting risk classification appears questionable. Rather than abandoning the correlation-based risk characteristic, a better result might be achieved by introducing additional information that affects the classification of certain risks. In other words, the introduction of additional risk

³⁰ Stephen S. Hecht, “Tobacco Smoke Carcinogens and Lung Cancer,” *Journal of the National Cancer Institute*, Vol. 91, No. 14, July 21, 1999, p. 1194. The quoted statement is from B. N. Ames, L. S. Gold, W. C. Willett, The causes and prevention of cancer, Proceedings of the National Academy of Sciences, 1995; 92:5258-65.

³¹ “The Health Consequences of Smoking: A Report of the Surgeon General,” May 27, 2004, p. 15

³² Actuarial Standard of Practice No. 12, paragraph 3.2.2

³³ Predictiveness of Credit History for Insurance Loss Ratio Relativities, Isaac Fair (1999); The Impact of Personal Insurance Credit History on Loss performance in Personal Lines, James D. Monaghan et al (2000)

characteristics, such as an individual's personal driving record or additional detail regarding the reasons for a low credit rating, may facilitate a more accurate assessment of such special cases.

2. Absence of Ambiguity

In an effective risk classification system, the set of risk classes is collectively exhaustive and mutually exclusive so that, once a factual assessment of an individual risk has been made, as little ambiguity as possible exists concerning the class to which that risk belongs.

3. Homogeneity and Credibility

The homogeneity of risk classes was discussed in Section III.C above. As was noted there, a refinement of a risk classification system improves the homogeneity of the risk classification system. For risk classes based on the risk characteristic "occupation," for example, replacing "nurse" with a listing of nursing specialties with detailed descriptions could result in increased homogeneity.

If risk classes are insufficiently homogeneous, adverse selection can occur. But, as was also noted, increasing the number of risk classes may decrease the credibility of estimates based on data obtained by observing the results for the classes over time. The credibility of the data accumulated for nurses as a group, for example, will be greater than the credibility of the data for each listed specialty. Achieving a balance between homogeneity and credibility is a major consideration in the establishment of risk classes.

If risk classes are homogeneous, it does not follow that the risks assigned to the class will have identical or even similar actual outcomes. Homogeneity of risk classes implies that the risks in each class have similar risk probabilities. If the data gathered through observation of the outcomes is fully credible, the average frequency of past occurrences will be a good predictor of the average frequency of future occurrences. The individual occurrences will be distributed around the average, with some individual results being more favorable and some less favorable than the average. Individual outcomes are not predictable.

Altering the number of risk classes alters the balance between homogeneity and credibility. Both are important considerations. Setting the balance requires taking into account the purpose of the security system. There is no one statistically correct risk classification system for a given set of risks. In the final analysis, the risk classification system adopted will reflect the relative importance ascribed to each of these considerations. The decision as to the proper balance will, in turn, be influenced by the nature of the risks, the goals of the security system and the

judgment of the designer of the risk classification system.

The amount of available historical data for one or more risk classes often increases over time.³⁴ At some point, it may be possible to refine the original risk classes into more homogeneous subclasses, using a credibility method to estimate the corresponding risk probabilities as a blend of estimates based on the data for a specific subclass and on the data for the original risk class. This will be more fully discussed in Subsection D below.

4. Expense and Practicality

An important consideration in the design of a risk classification system is the level of operational expense. Operational expenses include those for establishing risk classes, for assigning each risk to a risk class, and for determining a price of coverage for each risk in the risk class.

The cost of utilizing a given risk characteristic should be reasonable in relation to the benefits achieved for the security system and for the participants in the system. Considerations of expense sometimes can make the use of certain risk characteristics impractical. Life insurance underwriting for smaller policies, for example, may be carried out on a “non-medical” basis, meaning without the benefit of blood or urine tests or paramedical examinations. When expense considerations limit the risk characteristics that can be employed practically, the risk classification system is necessarily less refined.

D. MAINTENANCE OF A RISK CLASSIFICATION SYSTEM

If a risk classification system is properly designed, it will contribute to the success of the financial or personal security system it supports, not only in the short run, but also for as long as the system is in operation. Due to the dynamic nature of risk, changes may be required from time to time to maintain the effectiveness of the risk classification system. In some cases, simply changing the prices or other terms and conditions applicable to the various risk classes will suffice. In other cases, the risk classes themselves will need to be updated from time to time. Different considerations apply if changes are made to risk classes only for new participants than if changes are made to the classification of risks already covered by the security system.

³⁴ The use of historical data to estimate risk probabilities implicitly assumes that the risk probabilities do not change over the observation interval. For a discussion of the implications of relaxing this assumption, see Subsection D below.

1. Changes in risk classification applicable to risks not previously covered

In most cases, the coverage provider has the right to change the risk classification system provided the change only applies to risks not currently covered. This can be done in many ways. Introducing new risk characteristics, as was the case for smoking status for life insurance in the 1980s, will result in a refinement of the risk classification system for risks covered after a specified date. On the other hand changing from medical to non-medical underwriting for some form of life insurance coverage effectively reduces the number of risk classes. It also is possible to introduce risk classes that are not simply combinations or partitions of the existing risk classes. This may be the case, for example, if quantitative information about a medical condition based on a new test becomes available and replaces information based on qualitative assessments by physicians in the underwriting process.

Changing the risk classification system for new risks can affect the results for the risks already covered, since those participants who believe the new risk classifications would be more advantageous to them might, if permitted, drop their current coverage and re-apply for coverage under the new classification system. If this occurs, the average expected cost for the risks still covered under the original risk classification system could increase. If prices cannot be increased for these risks, the financial results of the coverage provider may suffer. If prices can be increased, the financial results initially may be acceptable, but since participant dissatisfaction may increase, the financial results of the coverage provider, and ultimately the success of the security system, may be compromised. On the other hand, if current participants are not permitted to drop coverage and re-apply under the new risk classification system, the participants who believe the revised classification system would benefit them are likely to be dissatisfied and may transfer their coverage to another provider, if this is possible.

A coverage provider could face the same adverse scenario if changes are made to a prevailing risk classification system by other coverage providers in the security system. Not matching the change could lead participants, if they believe they would benefit, to transfer their coverage, while matching the change could lead to the problems just described. Prospective changes to risk classification systems often have important consequences both for those providers adopting them and for those not adopting them.

2. Changes in risk classification applicable to risks already covered

In some cases, coverage providers may wish to make adjustments to the risk classification system and apply these adjustments to risks already covered. The desired adjustments could be prompted by changes in external conditions, such as

new medical treatments or changes in the economic environment, or by factors internal to the system, such as increased understanding of the covered risks due to the accumulation of data. In general, such adjustments only can be made if provided for in the terms of coverage. Such adjustments also may require regulatory approval. Approval may be withheld if the adjustment is based on changes that are not clearly indicative of a corresponding change in risk. The use of credit rating as a risk characteristic for automobile insurance, for example, may be accepted for initial risk classification, but reflecting reductions in credit rating that occur after the coverage is in force, especially if coincident with a downturn in the general economy, may be rejected.

Coverage providers may find it desirable to apply any adjustments to the risk classification system to existing as well as newly-covered risks to reduce the administrative burden created by proliferation of risk classes. Differentiating between existing and new risks will increase this proliferation. To illustrate, for some workers' compensation insurance systems, the risk classification process applicable to both existing and newly-covered risks is constantly reviewed and revised. Changes deemed warranted based on underwriting considerations, statistical data and actuarial analysis are adopted annually across the country. For workers' compensation insurance, the changes become applicable upon the next normal renewal of each insured employer's policy and are not limited to policies written after the revisions are adopted. If separate risk classes were established for newly written policies and each group of renewing policies, the risk classification system might be considered unmanageable by the coverage providers.

For security systems that provide coverage for one year at a time, such as the workers compensation example just discussed, it might be expected that any change in risk classification for existing risks would involve considerations similar to those that apply to a change in risk classification for newly-covered risks. But after the coverage has been renewed several times, the coverage provider may have captured a substantial amount of historical data for one or more risk classes. At some point, enough data could have accumulated that the data captured for subclasses of a risk class are sufficient to allow separate estimates of risk probabilities. In the case of employer-sponsored employee benefit programs, for example, all employers initially may be assigned to one risk class. For such security systems, an initial set of "manual" risk probabilities is estimated based on the experience of a large class, such as an entire industry.³⁵ As data specific to each employer group accumulates, a refinement of the original risk class into more homogeneous subclasses might be possible. In most cases, a credibility method is used to estimate the risk probabilities for each employer subclass as a blend of estimates based on the data specific to the employer group

³⁵ The term "manual" refers to the rate manual that was used in the past in connection with group cases.

and on the data for the original risk class. As the credibility of a specific employer group's data relative to the industry data increases, the estimates of risk probabilities, and thus the expected cost, increasingly reflect the employer group's own experience.

For longer-term coverages, changes in risk classes after the contract is issued are rare and may not be permitted: however, existing contractual differences can be used to place risks in separate classes. In rare instances, new contractual differences may be introduced to effect such separation. For example, in the early 1980s, a time of unusually high market interest rates, participating life insurance policies³⁶ written with a fixed loan interest rate were experiencing very high utilization of the policy loan provision by some, but not all, policyowners. This in turn caused the dividends payable to all policyowners to fall dramatically. Several insurers offered each policyowner the right to adopt a policy loan provision that provided either for a market-based "variable policy loan interest rate" or to have the degree of utilization of the policy loan feature for the policy to be recognized directly in the dividend paid to that policy. Those opting to accept the new policy loan provision were credited a higher interest rate than those opting to retain the original provision.

Risk characteristics that are not used or not legally allowed for setting prices may still be useful in management of a security system. Any refinement implied by accumulated historical data can be used to improve the accuracy of estimates used in managing the security system. Even in cases in which prices are not allowed to reflect a risk characteristic, the risk characteristic can be used to improve estimates of the security system's future obligations.

The use of historical data to estimate risk probabilities implicitly assumes that the risk probabilities do not change over the observation interval. If the risk probabilities change in a predictable manner, as is the case for mortality rates, a trending procedure can be used in conjunction with historical data. If changes in the risk probabilities are not predictable, guaranteeing the price and other terms and conditions may be problematic.

3. Changes in price for existing risk classes

Prices and other terms of coverage that apply to each risk class may be adjusted either prospectively or retrospectively in order to reflect the variation of actual outcomes from the outcomes assumed initially. Actual outcomes will differ from expected outcomes as the result of either random fluctuations or mis-estimation of the risk probabilities. If the sum of the cost of coverages for all covered risks is

³⁶ Insurance policies are "participating" if they pay dividends to policyowners.

appropriate, the part of the price of coverage that stems from mis-estimation of the expected costs of coverage for individual risk classes is, in effect, a subsidy either paid or received by the risk class. Adjustments may be made to reflect improved estimates of risk probabilities for the risk classes so that actual outcomes differ from expected outcomes for a risk class only because of random fluctuations. This process has been called the improving of “predictive accuracy.”³⁷

a. Prospective Experience Rating

Prospective experience rating is a process under which the price of coverage for risks within a risk class is increased or decreased periodically to equal the then expected cost of future coverage, augmented by any necessary additional provisions. Prospective adjustment of prices and other terms of coverage can increase the effectiveness of the risk classification system, reinforce individual equity and reduce adverse selection. Examples of prospective experience rating include pricing changes based on the credibility-based refinements discussed above and changes to “non-guaranteed elements,” such as the current interest rates and cost of insurance rates associated with life insurance and annuities.

b. Retrospective Experience Rating

Retrospective experience rating is a process under which the price of coverage for risks in a risk class is increased or decreased periodically so that the current monetary value of the amounts paid in aggregate by the participants approaches, ever more closely, the current monetary value of the mitigating actions taken by the coverage provider, augmented by the necessary additional provisions. Retrospective experience rating may be used with group insurance and commercial property and casualty coverages.

c. Participating Coverages and the Contribution Method

The “contribution method” used by some participating life insurance and annuity systems has similarities to retrospective experience rating. The price for coverage for participating life insurance is stated as the difference between a guaranteed “premium” and a non-guaranteed “dividend” that varies by risk class. Each year, an aggregate amount (“distributable surplus”) is determined, representing the amount that prudently can be returned to the participating policyowners. Under the contribution method, the dividend for each risk class

³⁷ G. G. Venter, “Experience Rating—Equity and Predictive Accuracy,” *NCCI Digest, Vol. I, No. 1*, April 1987

is intended to represent a proportionate share in the divisible surplus, based on the net contribution made by the risk class. Since the net contribution takes into consideration actual overall experience of the risk class, the dividend has the effect of adjusting the price paid by each participant toward the cost of coverage that would result from the experience rates of mortality, interest, expense and other factors applicable to risks in the risk class, augmented by any necessary additional provisions. The process of setting the divisible surplus and the resulting dividends can be managed so that the price of coverage for each risk class approaches, ever more closely, the current monetary value of the mitigating actions—but not all coverage providers choose to do so.

4. Generational risk classification

In the design of a security system intended to last for a period that exceeds the life expectancy of most participants, the temptation of “borrowing from the future” to permit current benefits to be provided at less than expected cost is always present. Risk classification can provide a means to deal explicitly with this problem.

When designing a security system that is intended to last for many generations, such as many social insurance systems, careful consideration must be given to the maintenance of equity between risks that are accepted for coverage at different times. A *cohort* of risks is a set of similar risks that begin coverage during the same interval of time. In effect, cohorts are risk classes for which the date of coverage initiation is used as a risk characteristic. Cohorts are affected similarly by changes in the system over time, whether these changes are due to natural causes (such as improvements in longevity) or policy causes (such as deferral of funding).

Intergenerational equity is individual equity within a security system between participants who are from different cohorts. In order to maintain intergenerational equity, the prices that each cohort pays must be reasonably related to that cohort’s expected costs of coverage. If the full price of coverage is not paid by one cohort, it will have to be paid by another via an internal subsidy (between cohorts) or by a future external subsidy. Since the cost of coverage is paid some period of time after it is incurred, the cost of capital applicable to the security system will affect how significant this subsidy must be.

As previously discussed, subsidies could be appropriate, depending on the goals of the system. Intergenerational subsidies need careful consideration, however, since without careful planning these subsidies can become so extensive that at some point the security system will be unable to continue. Intentional intergenerational subsidies may be used when a new benefit is introduced and the

initial cohorts would not have sufficient time to generate adequate funding. Such unfunded accrued liabilities frequently are established in connection with pension plans, including social insurance pension systems. The intention usually is to pay down the unfunded liabilities over a fixed period of years through external subsidies provided by the plan sponsor. This approach has often been employed successfully, but success usually requires careful monitoring and frequent reassessment of the financial status of the security system.

E. SOCIAL, LEGAL AND REGULATORY CONSIDERATIONS

Security systems do not exist in a vacuum. Security systems that do not find acceptance with the public may not be able to carry out their functions successfully. The foundation of public acceptance for security systems intended to provide for the needs of a broad at-risk group over a long time horizon is built through the achievement of the success criteria introduced in section I.G. A public perception can develop in some cases, however, that the response of a security system is inadequate. Everyone is faced with risk, and to the extent those with limited financial resources or those who are identified as having special needs are perceived to face inadequacy of coverage obtained or obtainable, public dissatisfaction occurs. Such concerns have led to legal or regulatory limitations on risk classification. These limits, however, can have significant adverse effects and compromise the ability of the security system to meet the success criteria. Some examples are discussed below.

1. Public Acceptability

Any risk classification system should be designed with awareness of the values of the society in which it is to operate. To be regarded as generally acceptable from a societal perspective, a risk classification system in most cases must be perceived to be based upon clearly relevant data, to respect personal privacy, to be structured so that the risks tend to identify naturally with their classification and not to differentiate unfairly among risks.

The public is rarely uniform in its opinions, of course, and a given issue is likely to be influenced heavily by the opinions of those who are affected directly by specific risk classification actions. This has been the case for some issues that have received substantial publicity, such as whether distinctions based on gender or credit rating are appropriate and whether coverage providers are engaging in “cherry-picking.”³⁸ Issues of this kind and the expressed concerns of individuals

³⁸ The term “cherry-picking” is often used in connection with security systems in which coverage is provided to a pool of heterogeneous risks at a price based on the average expected cost for these risks. Coverage providers are motivated to offer coverage at a reduced price to those risks with expected costs that are significantly lower than the average expected cost for all pool participants. This usually results in

who are affected directly deserve careful attention and any constitutional or legal requirements must of course be observed. The design of a risk classification system that is intended to serve a broad at-risk group over a long time horizon, however, should not ignore the success criteria introduced in section I.G. If recognition of the well-established differences in the mortality of men and women is prohibited in a competitive market for life insurance or annuities, for example, coverage providers may decide that prudence requires that prices be set to allow for the possibility that the coverage provider's mix of business will be skewed toward the gender that has the higher expected cost for that coverage (men for life insurance and women for annuities). If most coverage providers take this approach, the resulting prices for coverage could be only marginally better for one gender and significantly worse for the other.

In addition, public acceptance can depend upon the perception of whether or not certain types of coverage that are widely believed to be essential can be afforded by those with limited financial resources. Social adequacy was previously defined³⁹ as a goal, adopted by some security systems, of making coverage available to all or most of an at-risk group at prices that are considered affordable. In a security system that has social adequacy as a major goal, prices may not be consistent with individual equity. Although this may make designing the security system so that it meets the success criteria more difficult to achieve, social adequacy concerns are real and affect decisions regarding many types of security systems.

2. Concerns about risk classification

As this monograph is designed to illustrate, risk classification plays an important role in the success of a financial or personal security system. But, because risk classification can result in higher prices or less favorable terms of coverage for some risks, a broad spectrum of questions arise from consumers and policy-makers for which no single answer will suffice.

Some question the applicability of statistics to matters that impact individual human beings. To apply statistical analysis, an individual risk must be grouped with other risks having "similar" risk probabilities. To some, this approach appears to treat people as members of a group, rather than as individuals. From this point of view, any grouping—with the possible exception of a grouping based on risk characteristics, like smoking, that are subject to control by the risk subject—is tantamount to stereotyping.

an increase in the average expected cost of coverage for the pool, which may lead to an increase in the pool price.

³⁹ See the Glossary.

An important consideration to remember in this context is that risk classification classifies risks, not risk subjects. People are not placed into groups; rather their mortality risk or morbidity risk or longevity risk is. Houses, automobiles and other forms of property are not placed into risk classes; rather the associated covered risks are. Each risk subject has characteristics that can be useful in estimating the risk probabilities for the covered risk—the probabilities that a specific covered event will occur and will be of a given severity. To offer coverage to risks without reference to their respective risk probabilities could lead to the difficulties that doomed the assessment societies discussed in section II.B above. In some cases, a negatively-perceived risk classification system can be improved by adding one or more risk characteristics. The information provided by the additional risk characteristics could result in better estimates of the risk probabilities and also may improve the perception of participants and potential participants regarding the appropriateness of the classification system.

Objections also are raised on practical, rather than philosophical bases. Objections may be raised to a specific risk characteristic, for example, on the grounds that its relevance and predictive capability have not been sufficiently established. In some cases, the absence of a cause-and-effect explanation is cited. As discussed in section IV.C.1.d above, risk characteristics for which no such explanation is available nevertheless have been found to be useful and even have achieved public acceptance. As also discussed above, the acceptability of such a risk characteristic may be enhanced by willingness on the part of coverage providers to supplement the risk characteristic with other pertinent information about a specific risk. In other cases, a coverage provider may be utilizing the risk characteristic in question despite limited relevant historical data about the risk. This often occurs in situations in which risk factors are changing rapidly, as with a new treatment for a disease, or travel or deployment to a region newly engulfed in war or civil conflict. The rapid change may make initial estimates of risk probabilities difficult. A commitment to continue to update risk classifications and prices as current relevant data become available is one way to achieve greater acceptance in such situations. In addition, the presence in a competitive market with a number of coverage providers is helpful to the potential participant seeking coverage for such a risk, since the providers are likely to assess rapidly changing situations differently and thus would likely offer a wide range of choices.

3. Legal and regulatory restrictions on risk classification

Risk classification classifies risks, not risk subjects. This distinction is not always recognized by individual participants in a security system. Moreover, even when this distinction is recognized, the economic impact of ignoring the differences between risks is often disregarded in public policy debates.

Many states have adopted laws based on the National Association of Insurance Commissioners (NAIC) model Unfair Trade Practices Act, which prohibits “unfair discrimination” but allows “risk classification based on sound actuarial principles and actual or reasonably anticipated experience.”¹ Other NAIC model laws and regulations are consistent with this approach. Similar language is found in state laws and regulations relating to rate filing.² The North Carolina Administrative Code, for example, requires a statement by an actuarial expert that health maintenance organization premiums “are established in accordance with actuarial principles for various categories of enrollees and are not excessive, inadequate or unfairly discriminatory.” Regarding the inclusion of risks with demonstrably different risk probabilities in the same risk class, a 1973 opinion of the Attorney General of Washington³, states “*equality of treatment may be denied as much by requiring apparently identical benefits be provided to persons unequally situated as by requiring different benefits to be provided to persons equally situated.*” (Emphasis in original).

There are situations, however, in which laws and regulations have been adopted that constrain or put limits on risk classification in certain circumstances. These actions often are taken in reaction to specific individual circumstances and to public concern that these circumstances engender. The *Manhart*⁴ decision by the Supreme Court, as well as subsequent employment law, for example, prohibits requiring different employee contributions for similar pension benefits for male and female employees. A small number of states prohibit gender-distinct rates for annuities and, less frequently, life insurance. Numerous limitations on risk classification apply to health insurance. The restriction on the recognition of pre-existing conditions in the “Patient Protection and Affordable Care Act” (PPACA)⁵ passed by the U.S. Congress in 2010 is a notable example.

Restrictions on the use of the pre-existing conditions as risk characteristics are instructive in two ways.

First, when the criteria necessary for the success of complex financial or personal security systems are subordinated to other public policy concerns, the issues that

¹ Unfair Trade Practices Act, NAIC MODEL LAWS, REGULATIONS AND GUIDELINES 880-1, §4 (2007). Model laws, regulations and guidelines adopted by the NAIC are adopted, sometimes with revisions, by the various states at their discretion.

² See, e.g., 11 N.C. Admin. Code 12.0321 (2011); Va. Code. Ann. § 38.2-1909 (2011). See also Guidelines for Filing of Rates for Individual Health Insurance Forms, NAIC MODEL LAWS, REGULATIONS AND GUIDELINES 134-1, §§ 1-2 (2010); Property & Casualty Rating Law (prior approval version), NAIC MODEL LAWS, REGULATIONS AND GUIDELINES 1780-4, § 4 (2009).

³ 1973 Wash. Att’y Gen. Op. No. 21, (Oct. 11, 1973), available at www.atg.wa.gov/AGOOpinions/opinion.aspx?section=archive&id=6930.

⁴ Los Angeles Dep’t Water and Power v. Manhart, 435 U.S. 702 (1978).

⁵ Patient Protection and Affordable Care Act, Pub. L. No. 111-148, 124 Stat. 119 § 1201 (2010).

spurred the resulting laws and regulations very well might prove less significant than the future problems that stem from them. Restrictions on risk classification often emerge from public awareness of individual situations that appear contrary to the spirit of public policy. This was the case with restrictions on pre-existing conditions. In some cases, individuals who left employment with a pre-existing health condition found it hard to purchase individual health insurance. It seemed appropriate to address these issues with restrictions on the use of pre-existing conditions. But if health insurance is made available without regard to pre-existing conditions, there is less reason for purchasing coverage while in good health. A health insurer in a state that had adopted “open enrollment”, for example, received a letter from a woman who had recently purchased a policy. She praised the company for providing maternity benefits and added that she was cancelling the policy, but would be sure to purchase another policy if she was going to have another baby.⁴⁵ If no one were to pay premiums except when receiving benefits, the financial result would, of course, be unacceptable.

Second, the actions needed to incorporate restrictions on risk classifications into a security system without jeopardizing its long-term success might prove unacceptable to the public. Restriction of the use of pre-existing conditions is economically viable only on the premise that all citizens continually have similar coverage. Were this condition actually in place, the possibility of individuals purchasing health insurance only after their health has deteriorated would be eliminated. Assuring that this condition holds, however, is not easily accomplished. The Patient Protection and Affordable Care Act (PPACA) attempts to achieve this result by requiring everyone to either purchase health care coverage meeting certain standards or pay a penalty.⁴⁶ For such a mandate to work, the penalty should be greater than the advantage that would be gained by deferring the purchase of coverage until benefits are payable. A penalty of this magnitude would likely be unpopular, and a much lower penalty is provided in the law as adopted.

4. Risk adjustment

In a competitive system, if risk classification is limited in any way, each permitted risk class will contain a mixture of risks with different risk probabilities. The need to reflect this mixture when setting prices for coverage can create problems that affect the ultimate success of the security system. The form the problems take is affected by the terms of coverage—specifically, by the conditions under which coverage may be terminated and prices may be changed.

⁴⁵ “Perils of Pioneering: Health-Care Reform in State of Washington Riles Nearly Everyone,” *The Wall Street Journal*, April 5, 1996.

⁴⁶ Patient Protection and Affordable Care Act, Pub. L. No. 111-148, 124 Stat. 119 § 1201 (2010).

Some coverages—for example, single premium immediate annuities⁴⁷—cannot be terminated by either party and the price and other terms of coverage cannot be changed. Thus, if its risk classes contain mixtures of risks with different risk probabilities and if it cannot know in advance what the mixture will be, a coverage provider will tend to set prices using a conservative assumption about the mix. This will likely result in more being paid for coverage in the aggregate than would be the case if risk classification was not limited. It also will result in reduced demand by those with low relative cost risks and increased demand by those with high relative cost risks.

On the other hand, if coverage can be terminated by the participants but not by the coverage provider and the price for coverage can be changed annually or at regular intervals, the coverage provider is not locked into its initial assumption about mix of risks. If its risk classes are inhomogeneous, the coverage provider has the right to adjust the price to the level appropriate for the mix. The ability to raise prices to cover expected costs is limited, nevertheless, since participants can switch coverage providers to obtain a lower price. A coverage provider cannot be sure whether its prices will cover its expected costs, and this uncertainty could cause coverage providers to withdraw from the market.

If coverage can be terminated by the participants but not by the coverage provider and if prices cannot be changed, providers with an unfavorable initial mix of risks will have losses or reduced profits locked in. Providers with a favorable initial mix could have a windfall. If the coverage providers serve different segments of the market and if some segments have less favorable mixes than other segments, the companies serving those segments will have worse experience and are likely to raise prices for future applicants. The result could be that some market segments will have higher prices for all participants (i.e., both those with low relative cost risks and those with high relative cost risks).

Risk adjustment is a process under which the actual or expected cost of coverage for one or more specified risks is shared by all the system's coverage providers in such a way that the providers should be indifferent to the presence of certain risk characteristics. Risk adjustment has been proposed as a solution to problems of the sort just discussed. Risk adjustment typically is carried out by segmenting, in each risk class, the risks that have the specified risk characteristics (e.g., an inherited tendency toward a disease). The “excess expected cost” for these risks then is shared among the coverage providers on a basis (such as total revenues) that is independent of the segmented risks. The excess expected cost then acts like

⁴⁷ An immediate annuity is an annuity for which payments begin immediately (usually within a year of purchase). The term is used to distinguish this type of annuity from a “deferred annuity,” for which payments are deferred for a period of time.

a “tax” on the revenues, leading, at least in theory, to a small overall increase in prices and only minor disruption of the normal pricing within the security system. The segments themselves are, of course, risk classes. Viewed in this way, risk adjustment, rather than “replacing risk classification,” as is sometimes claimed, is simply a refinement of the permitted risk classes, together with a process under which one set of risk classes receives internal subsidies from the remaining risk classes.

Risk adjustment by itself often is insufficient to ensure achievement of the three success criteria for security systems—coverage that is widely available to those in the at-risk group who desire it, sufficient acceptability of the terms of coverage, taken as a whole, to those who are eligible to become participants, and sufficient resources to ensure the fulfillment of the system’s promises. Risk adjustment could be effective in improving the availability of coverage, as long as there are no restrictions on the inclusion of the expected cost of the redistributed risks in prices. Risk adjustment may be acceptable to participants and potential participants in situations in which the redistribution (the tax) is small relative to each coverage provider’s total revenue. If the price increase necessitated by the redistribution is perceived as too large, however, the non-segmented risks will tend to utilize substitutes, including self management of the risk. A price spiral then could result and both the acceptability of the terms of coverage and the resources necessary to fulfill promises could be in doubt.

The effectiveness of risk adjustment in facilitating the achievement of the success criteria is dependent on the ability to determine an “excess expected cost” that is agreed to by all coverage providers and that accurately redistributes the cost of coverage over time. If the coverage providers have different views about the excess expected cost, some providers may be reluctant to participate in the market, thus limiting the availability of coverage. If an inability to estimate the excess expected cost accurately leads to periodic fluctuations in the price of coverage, the result may be unacceptable to many participants and potential participants. In addition, if the excess expected cost is misestimated, the risk adjustment process could produce windfalls for some coverage providers and financial instability for others, especially if the level of redistribution is high. Since the estimate of the excess expected cost directly affects the relative financial viability of the coverage providers within the security system as well as the prices paid by various groups of participants, the estimation process is likely to be subject to pressures from many sides. Insulating the estimation process from such pressures can prove difficult.

The effectiveness of risk adjustment also depends on finding a suitable basis for redistribution of the excess expected cost, especially if the excess expected cost is substantial. Any basis for redistribution will tend to favor, or at least to be

perceived as favoring, some participants and some coverage providers over others. Frequent review of the basis may be necessary.

5. Impact of legislative and regulatory actions affecting risk classification

Possible legislative and regulatory actions affecting risk classification systems, including restrictions on the use of certain risk characteristics and the imposition of procedures such as risk adjustment, should be considered together with their potential side effects, especially those that interfere with the security system's ability to meet the success criteria cited throughout this monograph as being necessary, though not necessarily sufficient, for success. Although such actions might seem appropriate responses to public policy issues from certain constituencies or constituencies at large, they may interfere with the system's ability meet the three criteria for success and thus can lead to the system's ultimate failure. Security systems fill a unique and important role in assuring the economic well-being of society. Impairing their ability to fulfill this role can have serious consequences that may not be apparent for years or even decades to come.

APPENDICES

BACKGROUND

In 1980, the American Academy of Actuaries published the *Risk Classification Statement of Principles*. In 1989, as the need for more formal guidance on risk classification increased and as the selection process became more complex and more subject to public scrutiny, the Actuarial Standards Board adopted the original ASOP No. 12, titled “Concerning Risk Classification”. ASOP No. 12 was revised December 2005 and re-titled “Risk Classification (for All Practice Areas)”.

A chronology concerning the literature on the subject is presented in Appendix 1 of ASOP No. 12 of which the background portion is reproduced below. It is followed by a description of the events leading to this document. The following is from Appendix 1, ASOP No. 12.

“Risk classification has been a fundamental part of actuarial practice since the beginning of the profession. The financial distress and inequity that can result from ignoring the impact of differences in risk characteristics was dramatically illustrated by the failure of the nineteenth-century assessment societies, where life insurance was provided at rates that disregarded age. Failure to adhere to actuarial principles regarding risk classification for voluntary coverages can result in underutilization of the financial or personal security system by, and thus lack of coverage for, lower risk individuals, and can result in coverage at insufficient rates for higher risk individuals, which threatens the viability of the entire system.

“Adverse selection may result from the design of the classification system, or may be the result of externally mandated constraints on risk classification. Classes that are overly broad may produce unexpected changes in the distribution of risk characteristics. For example, if an insurer chooses not to screen for a specific risk characteristic, or a jurisdiction precludes screening for that characteristic, this may result in individuals with the characteristic applying for coverage in greater numbers and/or amounts, leading to increased overall costs.

“Risk classification is generally used to treat participants with similar risk characteristics in a consistent manner, to permit economic incentives to operate and thereby encourage widespread availability of coverage, and to protect the soundness of the system.

“The following actuarial literature provides additional background and context with respect to risk classification:

- a. In 1957, the Society of Actuaries published *Selection of Risks* by Pearce

Shepherd and Andrew Webster, which educated several generations of actuaries and is still a useful reference.

- b. In 1980, the American Academy of Actuaries published the *Risk Classification Statement of Principles*, which has enjoyed widespread acceptance in the actuarial profession. At the time of this revision of ASOP No. 12, the American Academy of Actuaries was developing a white paper regarding risk classification principles.
- c. In 1992, the Committee on Actuarial Principles of the Society of Actuaries published “Principles of Actuarial Science”, which discussed risk classification in the context of the principles on which actuarial science is based.”

As noted above, *Risk Classification Statement of Principles* enjoyed widespread acceptance in the actuarial profession and, at the time of the adoption of the 2005 revision of ASOP No. 12, the American Academy of Actuaries was developing a *White Paper* regarding risk classification principles. This document is that “*White Paper*”. The portions of *Risk Classification Statement of Principles*, which were considered appropriate to an ASOP, were incorporated in the 2005 revision of ASOP No. 12. However, the background and elucidating material in *Risk Classification Statement of Principles* is appreciated by the profession and is considered valuable. It is the purpose of this document to capture that material. It is intended that the combination of the 2005 revision of ASOP No. 12 and this document will cover the matters addressed in *Risk Classification Statement of Principles*, as well as developments since its publication in 1980.

Throughout the paper are direct quotations from ASOP No. 12, “Risk Classification (for All Practice Areas).” This is to provide context and continuity. It is also to illustrate the fact that practice in this area is guided by a standard of practice. The quoted words derive their normative value from the fact that they appear in ASOP No. 12 and not from the fact that they appear in this document. As mentioned in the Preface, this document was not promulgated by a standard setting body and is not binding upon any actuary.

GLOSSARY OF DEFINED TERMS

This glossary consists of those terms defined in the body of the monograph. Many of these terms are in everyday use by actuaries and other practitioners concerned with risk and variations in their definitions are common. The definitions used in this monograph are intended to facilitate the understanding of the text and should not be taken to be authoritative or specifically endorsed by the American Academy of Actuaries or any other organization.

Advance risk transfer. *Advance risk transfer* is a commitment by one party to take specific action to mitigate the impact of certain risks that face another party.

Adverse selection. *Adverse selection* is an action⁴⁸, including an action regarding participation or any element of choice, taken by a current or potential participant in a financial or personal security system (1) that is based on information not available to or not used by one or more of the coverage providers within the system but known or believed by the participant to be true, and (2) that is perceived to confer a financial advantage on the participant.

At-risk group. An *at-risk group* is a group of individuals or entities facing possible unfavorable outcomes arising from one or more specified uncertain events.

Cohort. A *cohort* of risks is a set of similar risks that begin coverage during the same interval of time.

Compulsory system. A financial or personal security system is *compulsory* if it provides coverage for the members of a specified group and all members of the group are required to participate.

Compulsory system with elements of choice. A *compulsory system with elements of choice* is a compulsory system in which the participant is able to make choices about coverage or coverage providers.

Coverage provider. A *coverage provider* is an entity associated with a financial or personal security system that, in return for payments or other consideration, agrees to take actions which mitigate the unfavorable outcomes of specified risks through advance risk transfer.

Covered event. A *covered event* is an event with one or more outcomes that require the coverage provider to take mitigating actions involving monetary payments or the

⁴⁸ The action can be either positive or negative; for example, either accepting or declining a coverage provider's offer of coverage.

provision of goods or services, as provided under the terms of coverage.

Covered risk. A *covered risk* associated with a financial or personal security system is a risk for which the possible outcomes are the mitigating actions that would be undertaken by a coverage provider upon the occurrence of one or more of the system's covered events.

Cover; provide coverage for. A financial or personal security system *covers*, or *provides coverage for*, those who participate in the system.

Credibility. *Credibility* is a measure of the predictive value attached to a particular body of data relative to that of some other body of data.

Current monetary value. The *current monetary value* assigned to an economic good or service at a particular time by a participant or a coverage provider is an amount of money such that the participant or coverage provider is indifferent between the amount of money and the economic good or service.

Expected cost of providing coverage for a covered risk. The *expected cost of providing coverage for a covered risk* is the sum of the products of the current monetary value of each outcome of the covered risk and its associated risk probability.

Expected-cost-related prices. A set of prices is *expected-cost-related* if each price reflects the expected cost of providing coverage augmented by provisions for fluctuations of the actual cost around the expected cost, for uncertainty related to the process of estimation, for expenses and for profit or contribution to surplus.

External subsidies. *External subsidies* are additional resources provided by a source outside the coverage provider that permit some prices for coverage to be less than the corresponding expected cost of coverage.

Financial or personal security system (security system). A *financial or personal security system (security system)* is a private or governmental arrangement that is intended to offer a means to mitigate the impact of unfavorable outcomes on some or all of the members of an at-risk group through advance risk transfer.

Fully competitive system. A *fully competitive system* is a financial or personal security system with multiple coverage providers that are free to offer terms of coverage and prices of their own choosing, and among which potential participants are free to choose.

Individual equity. A set of prices for coverage achieves *individual equity* if prices are reasonably proportional to the corresponding expected costs of coverage.

Intergenerational equity. *Intergenerational equity* is individual equity within a security system between participants who are from different cohorts.

Internal subsidies. A set of prices for coverage within a financial or personal security system involves *internal subsidies* if the aggregate balance for each coverage provider is maintained by charging some participants more, and some less, than their expected costs of coverage.

Monetary risk. A *monetary risk* is a risk for which the outcomes are expressed in monetary terms.

Necessary additional provisions. *Necessary additional provisions* are charges made by a financial or personal security system, in addition to the charge for the expected cost of coverage, to provide for fluctuations around the expected cost of coverage and for uncertainty related to the process used to estimate it, as well as for expenses and for profit or contribution to surplus.

Non-monetary risk. A *non-monetary risk* is a risk that is not a monetary risk.

Participant. A *participant* in a financial or personal security system is a member of an at-risk group for whom coverage is provided by the system.

Peril. A *peril* is a cause of possible injury or loss at times in the future.

Price for coverage. A participant's *price for coverage* for a risk by a financial or personal security system is the amount that must be paid by or on behalf of the participant in order that the participant will receive coverage for that risk under the system.

Price spiral. A *price spiral* is a repetitive process that occurs in voluntary security systems and compulsory security systems with elements of choice when an upward adjustment of prices intended to remedy a shortfall in resources leads to an exodus of risks having expected cost lower than price, and thus to a continued shortfall.

Prospective experience rating. *Prospective experience rating* is a process under which the price of coverage for risks within a risk class is increased or decreased periodically to equal the then expected cost of future coverage, augmented by any necessary additional provisions.

Provide coverage for; cover. A financial or personal security system *covers*, or *provides coverage for*, those who participate in the system.

Refinement of a risk classification system. A *refinement of a risk classification system* is a risk classification system obtained by dividing one or more of the original risk classes.

Retrospective experience rating. *Retrospective experience rating* is a process under which the price of coverage for risks within a risk class is increased or decreased periodically so that the current monetary value of the amounts paid by the participants approaches, ever more closely, the current monetary value of the mitigating actions taken by the coverage provider, augmented by any necessary additional provisions.

Risk. A *risk* is a situation, created by a peril, that gives rise to a defined set of potential outcomes and the probability of occurrence associated with each outcome.

Risk adjustment. *Risk adjustment* is a process whereby the actual or expected cost of coverage for one or more specified risks is shared by all the system's coverage providers in such a way that the providers should be indifferent to the presence of certain risk characteristics.

Risk characteristic. A *risk characteristic* of a risk subject associated with a risk is an observable quality of the risk subject that gives useful information about the likelihood of the occurrence or about the severity of the outcomes associated with the risk.

Risk class. A *risk class* is a set of covered risks grouped together by a coverage provider based on its knowledge or belief that the risk probabilities of the possible outcomes associated with each risk in the class are substantially similar.

Risk classification. *Risk classification* is a process by which risks that have substantially similar risk probabilities can be grouped and their outcomes observed over time.

Risk classification system. A *risk classification system* of a coverage provider is a set of risk classes, together with a procedure that is used to assign each covered risk to one of the risk classes.

Risk probability. The *risk probability* of an outcome associated with a monetary risk is the probability that the outcome occurs at a particular time and is of a particular severity.

Risk subject. A *risk subject* is a person or thing, or a collection of persons or things, associated with a risk.

Security system. See *financial or personal security system*.

Service provider. A *service provider* is an entity that provides services, other than advance risk transfer, that mitigate the unfavorable outcomes of a covered risk.

Severity. The *severity* of a particular outcome of a monetary risk is the monetary loss associated with the outcome.

Single-provider system. A *single-provider system* is a financial or personal security system with only one coverage provider.

Social adequacy. To the extent a financial or personal security system makes coverage available to all or most of an at-risk group at prices that are deemed to be affordable, the system achieves *social adequacy*.

Terms of coverage: For a specific coverage offered by a coverage provider, the *terms of coverage* is a description of the rights and responsibilities of the coverage provider and of the participants to whom it provides coverage.

Voluntary system. A financial or personal security system is *voluntary* if an individual to whom coverage is offered has the right to choose whether or not to participate.