Risk, Uncertainty, and the Welfare State:

The Political Economy of Crisis Management

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A. Introduction: Public Policy and Risk Management

It is well known that democratic governments have adopted a wide variety of policies that manage risks. Examples include building codes and speed limits, safety regulations for food, drugs, and the work place. Civil law, criminal law, and national defense may be said to reduce risks associated with contract, theft, murder, and invasion. Democratic governments also routinely provide insurance and insurance-like services such as annuities. Yet if one looks at a modern economics or political science text books, there is little discussion of the broad range of risk management services provided by governments; nor of the fact that voters demand that "their" governments focus much of their resources on managing risks. There are goods and services to be provided, but not risks to be managed.

This book suggests that if one wants to understand the politics and policies of well-established democracies, the place to start is with an analysis of risks and crises faced by ordinary voters, rather than with the mathematics of public goods and externalities problems or agency problems, as focused on by most economist, or on the ideological, ethnic, and class coalitions and contests focused on by most political scientists.

This is not because the academic analyses of externalities, ideology, or redistribution are filled with errors, but because those analyses do not focus on the right problems, and so they cannot account for very much of the past century of policy development, nor the politics that motivated that development. Although externalities are occasionally mentioned in policy debates and sweeping ideological statements are more than occasionally made by politicians and political activists, they are normally of secondary or tertiary importance in the public policies ultimately adopted. Military, economic, health, and ecological risks play a much more central role in policy debates and developments than "externalities" or grand "ideological" issues. They do so, because risks and uncertainties are more obvious and more salient to voters than the incentive problems focused on by most economists and political scientists.

Risk management, per se, is not a new aim for government policies, but the risks managed by democratic governments differ from those managed by history's authoritarian regimes. Authoritarian regimes have an interest in retaining their authority both for its own sake and for the economic and social benefits associated with their offices. They thus adopt a wide range of standing policies that reduce uncertainties associated with their offices. Offices are often made hereditary, dissent is suppressed through censorship and treason laws. Other policies are adopted to secure the support of elites and to avoid losses associated with outside forces. Monopoly privileges of various kinds, which shield their recipients from a variety of risks, are granted to important supporters, while armies and police forces are maintained to repulse invasions and maintain law and order. Many of these risk management services also benefit their residents, as emphasized by many political theorists (Olson xxxx, xxxx), and of course some policies are adopted to increase the fruits of office, for given levels of risk.

Democratic office holders also have an interest in retaining office, but doing so requires pleasing rather than controlling their citizenry. Insofar as the risks of interest to voters differ from those of political elites, so will the policies adopted by democracies. Thus, with the emergence of governments grounded on popular suffrage, there was a significant shift in the kinds of risks that governments came to address. Some of these risks were associated with industrialization, which as noted in *Perfecting Parliament* was generated by liberal economic reforms at more or less the same time that liberal political reforms produced constitutional democracy. The new risk management services demanded included various safety measures to reduce economic and health risks associated with industrialization. They also included insurance-like services that reduced risks from, poor weather, natural calamities and business cycles.

This book suggests that the emergence of the welfare state during the 20th century was largely a consequence of voter demands for increasingly broad risk management on the part of their governments. This is not to say that non-democratic governments in the past or present completely lacked policies analogous to those of a welfare state, but it is to say that the scale of late 20th century programs dwarfed their antecedents and were adopted to advance different goals. When Marie Antoinette famously said “let them eat cake” in the late eighteenth century, it was because of a dearth of bread for state programs that provided aid to the French poor of the eighteenth century. The Soviet Union of the twentieth century also had a variety of programs that might be regarded as social insurance, as with its national health service and food distribution system.

These were relatively broad safety net programs by the standards of the times, but were small relative to their twenty-first century counterparts in Western democracies.

It bears noting that most contemporary "welfare" programs are insurance like instruments, rather than simple efforts to redistribute wealth from the rich to the poor. This is not to say that redistribution does not take place, but rather to say that the policies adopted in democratic polities are not principally or overtly redistributive. It would be easy enough to simply take wealth from the wealthy and give it (or shares) to the poor with lump sum taxes and transfers, yet relatively little of this takes place in Western democracies. As may be also said of policies that address classic externality or public goods problems, both public goods and redistributive effects are largely, if not entirely, consequences of efforts to manage broadly shared risks.

It bears noting, however, that risk management is not the same as risk elimination, although there is some confusion about this point. Some risks are productive and in such cases risk management should increase, rather than reduce, risks. Electoral competition provides a systematic and relatively low cost method of replacing rulers who are ineffective, violate their promises, corrupt, or rude. Similarly, economic competition among for firms for consumers tends to reduce production costs and cause products to evolve in a manner pleasing to the average consumer. These are cases in which liberal reforms in the nineteenth and twentieth centuries increased risks (for office holders and firms) rather than reduced them.

This book suggests that more of the public policies of Western democracies can be explained as a consequence of demand for risk and crisis management than as a demand for public goods, transfers, or ideological objectives.

B. On the Wrong-Footedness of Postwar Public Economics

In 1954, Paul Samuelson wrote a paper titled the "Pure Theory of Public Expenditure." Although it was a short theory-paper published in a journal that normally focuses on empirical research and might have been missed if it had been written by a lessor scholar, that article had a profound effect on the manner in which the next several generations of economists would think about the "proper" role of government. Samuelson demonstrated that goods with particular characteristics--perfect shareability--are unlikely to be produced at welfare maximizing levels by private markets, but they could, at least in principle, be provided at such levels by governments.

A similar and complementary theory had been developed a few decades earlier by Arthur Pigou (1920, part II). Pigou argued that markets in which marginal private and social costs differed were also unlikely to produce outputs that maximize welfare or the social dividend. Such cases would need to be regulated or properly incentivised by government in some way to maximize welfare. For example, what came to be called Pigovian taxes might be imposed on pollution produced by industrial production to induce firms to take account of spillover costs that they would otherwise ignore. Pigou's book was revised and republished in 1952.

The Pigovian "externality" and Samuelsonian "pure public good," with their associated optimal tax concepts, became the core of postwar public economics, the large and active area of economics that deals with public policy analysis. They provided an important bridge between welfare economics and classic public finance. Their ideas could be, and were, used to rationalize all manner of regulations and public services, from military interventions to environmental taxes, from drug policy to subsidizing scientific research. From the 1950s forward, a good government (ideal government) has been defined as one that produces pure public goods at appropriate levels, effectively addresses externality problems, and minimizes the deadweight loss of taxation.

The problem with this perspective on public policy is not that it is entirely mistaken, but that it captivated economists, but few others. One never heard more than a small minority of politicians or public commentators mention the words "pure public goods" or "externaliteis" in making their cases for public policies. Like dancers on the wrong foot, public economists and politicians talked about policies with completely different vocabularies and modes of argument, and often stepped on each other toes by reaching substantially different conclusions about the best policies.

This was not because the economic ideas were difficult to explain and so could not be easily used in public. Both concepts can be explained in a few sentences.

Politicians and pundits not only used different words, but used different conceptual frameworks. Politicians and pundits usually attempted to persuade *voters* that new policies would make them *safer*, rather than slightly better off by adjusting

marginal costs or benefits or solving coordination problems. Although national benefits were often stressed, the benefits of internalizing externalities were (and are) rarely mentioned outside of academic conferences. This was not because the public good and externality concepts were so esoteric that only professors of economics could understand them, but evidently because they seemed relatively unimportant to non-economists.

This wrong-footedness was partly philosophical. Public economists are nearly all utilitarians, although not always self-consciously so. Utilitarianism is a branch of social philosophy that emerged in the nineteenth century, which argues that public policies should attempt to maximize the total happiness of the individuals in society (social utility). An implication of the usual representation of social welfare is that policy improves when it increases the welfare of the average person, although some persons may lose while others benefit.

However, relatively few voters are utilitarians and so arguments based on that normative theory are not always very convincing. Instead, most voters evidently use principle-based systems of ethics that in many ways resemble civil law. A good person does A, B, C, but not X, Y, or Z. Under many of these rule-based normative systems, each person has inalienable rights, which public policies should not trump, no matter whether others benefit or not. Other rights are alienable, but only when the person initially holding those rights agrees to transfer them to others, as occurs during voluntary exchange. Most rights-based normative theories, for example, conclude that one may not harvest the organs of a living person, even if doing so would save a dozen other lives. Pure utilitarians would regard a 12:1 gain in social welfare to be enough to justify such policies, even if they are a bit macabre. Many persons would regard trades of organs, even if voluntary, to be repulsive.[1]

Rights-based normative theories do not allow governments to simply take the resources they require, as with lump sum taxation, because "ownership" cannot simply be ignored by the state under such normative theories. Ownership is not a mere accounting entry. Rights-based arguments play roles in courts, where formal rights are defended and defined, and also in public policy debates, where disagreements about rights often plays a role in argumentation and debate. Consistent with such rights approaches is the fact that most liberal democratic constitutions include takings clauses which rule out such state actions--although "takings" is not always as clear an act as it may seem.

Moreover, relatively few of the policy areas in which externalities are considered important are subject to corrective incentives of the sort recommended by public economists. Mandates--thou shall and thou shall nots--are far more common than corrective taxes or subsidies. Such policies resemble civil law more than public economics. Similarly, very few welfare state programs simply redistribute wealth from the rich to the poor, as most utilitarian theories of distributive justice recommend.

Disagreements about the proper normative theory is not the only reason that policy debates rarely resemble those among academic public economists. Equally

[1] See Winer and xxxx (xxxx) for a collection of essays on how coercion, defined in various ways--but including violations of rights--limits public finance choices in democracies.

important is the fact that the problems that voters want to address are rarely textbook public goods or externality problems. Relatively few public services and regulations are instances in which a Samuelsonian pure public good is to be efficiently produced or an externality internalized. Many are pure private goods, many others are what Buchanan (xxxx) refers to as club goods. For example, there are many insurance-like programs conditioned on a variety of unfavorable outcomes that most recipients would prefer to avoid. They moderate unavoidable risks, rather than attempt to advance utilitarian ends.

Two of the largest areas of expenditure in contemporary Western democracies (health insurance or services and annuities [social security]) are pure private goods that produce few if any externalities. Both health care and education can be (and often are) produced privately and generate relatively minor external benefits. It is the persons educated or medicated that benefit, rather than their neighbors.

From the perspective of postwar normative public economics, most government policies are puzzling, confused, or corrupt. The fastest growing areas of expenditures by democratic governments in the post world war II period are pure private goods that generate few if any externalities, public pensions and health care. In many other cases, as with pollution and safety mandates, and in the body parts case mentioned above, public policies seem to reduce rather than increase social welfare at the margin. They do not simply take from relatively well endowed Peter and give to relatively poorly endowed Paul.

Public economics also implies that the arguments used by politicians and editorialists to discuss and rationalize public policies are completely off base. Public debates rarely included the words efficiency, optimality, or incentive problems. Instead, a broad range of risks are stressed.

At this point one may ask whether it is political discourse, rather than political economists, that is confused. As often lamented by James Buchanan (xxxx), contemporary welfare economics often seems better suited for advising benevolent dictators than affecting or understanding the policies adopted by democracies.

C. Enter Public Choice: "Sub-Optimal" Democratic Governance

In the decades after World War II, most public economists believed that their conclusions about ideal public policies were fundamentally "correct," but also recognized that governments for some reason were not following their "excellent" advise. One possible explanation for this discord was that governments were not the ideal social welfare maximizing agencies, often assumed by economists and democratic idealists.

With this in mind, a few economists and political scientists began to think about how rational persons, rather than utilitarian social planners, might behave within existing democratic political institutions. The result was the new field of public choice, or rational choice politics, a joint product of economics and political science. Several pioneering papers and books were written in the 1950s and 1960s, and the field gathered steam in the 1970s and 1980s as a sizable and growing group of scholars attempted to explain why we observed the policies that we have, rather than speculate about the best possible policies that could be imagined.

This literature produced the median voter theorem, which provides a very clear model of democratic policy making. It also produced a series of special

interest group models, in which narrow interest groups disproportionately influence the regulatory, tax, and tariff policies. Such groups normally advance minority rather than majority or universal interests. Interest group models suggested that lobbying within democracies tends to bias policies away from those that advance moderate voter interests in order to produce profits or advance the economic interests of well organized groups--e.g. those able to support broad lobbying campaigns or large enough to influence elections at the margin. (xxxx footnote refs)

The new rational choice–based election models implied that electoral polities tend to maximize the welfare of the middle of the road (median or average) voters on widely understood salient issues, and special interest groups at the less salient margins of public policy, rather than the "total" welfare of the society of interest. If voters, interest groups, and politicians had all been utilitarians, the public choice literature would have produced predictions and public policies similar to those recommended by public economics. However, the theory assumes that voters are largely motivated by relatively narrow economic and political interests, analogous to those of consumers, rather than the welfare of society as a whole.

As a consequence, the predictions of public choice analyses differed significantly from those implied by welfare economics and provided a possible explanation for the difference between observed policy and the "ideal" ones recommended by public economists and other academic policy analysts. Democratic politics are not inherently utilitarian either at the level of voters or at the level of institutions. Even policies that advance moderate voter interests tend not to be Pareto optimal or social dividend maximizing. The policies adopted may depart even farther from these philosophical goals insofar as they are adjusted at the margin to advance the interests of politically active firms and interest groups. Some voters count more than others.

As in the case of the public goods and externality models, public choice models provided a new logically consistent and powerful lens through which to understand public policy. However, again there is a significant dissonance between the models and politics as we observe it.

One would expect public policy debates to be filled with references to the interests of moderate voters or the profits of important interest groups who benefit from favorable public policies. There are certainly hints of such ideas in speeches and editorials, but the bulk of speeches on policies by politicians and essays by pundits stress general risks (including those are associated with the weaknesses of their opponents), rather than the interests of moderate voters or the profits of narrow interest groups.

Public choice models do not rule out the possibility that risk management may be the service of greatest interest to moderate voters or interest groups, but Public Choice analysis has not focused much attention on that commonplace aspect of electoral and interest group politics. One possible explanation for this lacuna is that the equilibrium models used can be applied most easily to predictable outcomes, such as those associated service levels or degrees of regulatory stringency.

D. On the Nature of Public Policy, Some Evidence from the U. S.

If one believed that governments were driven by the utilitarian arguments that drive modern public economics, one would anticipate that most central government programs would address national public goods and externality problems, and other matter would be left to markets, where the welfare economics predicts good (Pareto efficient) results. If redistribution consistent with utilitarian norms were also adopted, this would be consist of unconditional lump-sum grants from rich to poor. If, instead, the narrowest of public choice approaches were the reality, one would instead see resources simply shifted from one group to another based on their relative abilities to lobby for special favors. In such a nation, governments would simply be a grand bazaar for special favors, as modeled by Grossman and Helpman (xxxx), and policy would only accidentally address public goods and externality problems.

In more moderate election-based models, the policies in place would advance the interests of moderate voters, rather than well-organized interest groups. In that case, policies addressing public goods and externality problems would be adopted only if voters and interest groups were recognized "market failures" when they saw them, or were largely concerned with advancing utilitarian goals. However, if the electoral models are reasonably accurate, but voters are not particularly interested in externality and public goods problems, per se, the policies in place will reflect whatever the interests of moderate voters are, regardless of whether externalities are internalized or created by such policies. If the main concern of voters and interest groups is risk management, rather than public goods and externalities or redistribution, we would expect to see a variety of insurance like programs and regulations that explicitly attempt to reduce risks for moderate voters, which is what we do see.

Table 1.1 lists major expenditures made by the U. S. government. In 1990, national defense was the largest single category of expenditures. National defense is arguably a pure public good and so that this would be consistent with models that suggest that governments mainly provide pure public goods. In 2000, social security was the largest program, which is consistent with a transfer model of government programs. In 2010, healthcare was the largest program, which is consistent with an insurance model of government services.

Table 1.1 Major U. S. Federal Outlays by Function
(Nominal Dollars, Billions)

Function	**1990**	**2000**	**2010**
National Defense	299.3	294.4	693.6
Veterans Benefits	29	47	108.4
Health (all, non vet)	155.8	351.6	820.7
Social Security (pension)	248.6	409.4	706.7
Income Security (disability, unemployment etc)	148.7	253.7	622.2
Net Interest	**184.3**	**222.9**	**196.2**
Education	37.2	53.8	127.7
Transportation	29.5	46.9	92
Natural Resources and Environment	17.1	25	43.7
Community Development	8.5	10.6	23.8

Agriculture	11.8	36.5	21.4
Total	**1169.8**	**1751.8**	**3456.4**
Total Insurance and Risk Management	*910.3*	*1417.6*	*3016.7*
Pure and Near Public Goods	*345.9*	*366.3*	*829.3*
Redistributive	*454.8*	*764*	*1501.8*
CPI (standardized dollar)	0.765	0.581	0.459
GNP	5801	9952	14660
Population (millions)	250.132	282.385	308.745

Total Outlays is calculated from the table entries, and neglects several small categories of expenditures not included in the functional categories tabulated.
All data taken from the *2012 Statistical Abstract* except for the 2010 population estimate, which is from the US Bureau of the Census Website (downloaded 10-29-12).

If we examine the overall pattern of expenditures, rather than the largest programs, one of these three rationales for government programs clearly dominates. Among the functions that have a clear risk management or insurance interpretation are defense, which clearly attempts to moderate risks from invasion and preserve access to foreign goods and services. Social security (an annuity), health care (insurance), unemployment insurance, natural resource management and agricultural supports which reduce environmental risks and (in principle) stabilize prices for important goods and services. These risk management services account for somewhat more than 90% of U. S. central government expenditures in all three periods. (The chief omission is interest on the national debt, which could be regarded as a fee for borrowing to provide for risk management or crisis insurance in the past.)

Service areas that can be regarded as efforts to produce pure public goods or curtail important externalities includes national defense (and its associated benefits veterans), transportation (especially national and international networks), and environmental and natural resources expenditures (and regulations). These areas of expenditures accounted for over seventy percent of expenditures in 1990, but only a bit more than half in 2010.

Several of the expenditures areas listed have redistributive aspects, which may be regarded as instances of success for rent-extraction or as instances where the altruism or idealism of voters desire to shift resources from one group to another. The largest of these programs shift resources from the middle aged to the elderly. Another large program provides income security for the disabled, unemployed and poor (pre-retirement). Educational expenditures are also clearly transfers from the middle-aged to the young and persons employed in the education industry. Similar transfers take place to agriculture and to local communities. These arguably redistributive programs accounted for about 15% of outlays in 1990 and nearly 30% of outlays in 2010. (Healthcare is excluded because it is clearly an insurance program which would be no more redistributive than auto insurance, but for its means of financing.)

Table 1.1 suggests that the risk management accounts for a larger share of U. S. government expenditures than the alternative rationale's of public goods and transfers. Trends in this period favored redestributive programs over public goods programs, but neither theory of government policy accounted for as much of total

expenditures in any single period as that proposed by this book, namely risk management.

Similar patterns are also found in other OECD nations as discussed in chapters 11 and 12, where social insurance programs tend to be larger and defense budgets smaller.

E. Purpose and Organization of this Book

This book provides a general framework for thinking about risk and crisis management by households and by governments. It uses that framework to explain the emergence of the Western welfare state. It suggests that efforts to manage risks can explain a good deal of private behavior and, also a broad cross section of the policies adopted by governments.. That is to say, public debates do not reflect misunderstanding or mistakes about the "real" issues, but actually reveal what voters and government officials are actually concerned about, namely risk and crisis management. In this respect, it challenges the public goods, externality, and redistributive theories of the state that have dominated post-war economic consensus about norms for and the reality of public policy in democratic polities.

The book begins by suggesting that risk is not a minor froth on an otherwise placid predictable choice setting. The pages of most newspapers indicate that life is filled with both large and small risks. On the front pages, we learn of murders, bank failures, earthquakes, floods, and political and ecological turmoil. The obituary pages show that people die from many causes every day. Terminal illnesses and serious accidents evidently occur frequently, but not usually predictably. The business section notes bankruptcies and factory closings occur throughout the world on an irregular basis, at the same time that that stock and real estate markets zoom up and down in largely unpredictable ways. And, in the science sections, we learn that new potential risks and solutions to them are constantly being discovered and debated. It is the idiosyncratic (surprise) nature of many of these events that makes them newsworthy and of interest to readers. Risks and crises are everyday events, and "small" ones are so commonplace that we all have developed routines for dealing with them. In democracies, many of these risk limiting services are provided by governments.

The first part of the book develops attempts to explain the "obvious." Why it is that both individuals and governments devote so much of their efforts on risk management. The answer is simply that life is filled with unpleasant surprises and risks of such surprises. Part I analyzes both the sources of risks and the effectiveness of a variety of steps that private persons take to reduce risks and reduce losses associated with unpleasant surprises. In this, it revisits many of the questions that Frank Knight addressed in *Risk Uncertainty and Profit*, but with an eye to explaining the scope and organization of the state, rather than the private sector, which he does so masterfully in that classic book.[2]. Chapter 2 argues that risk and uncertainties are central features of life, rather than froth on the glass that can be or should be neglected. As a consequence, forward looking individuals will take risk and uncertainties into account when making plans. Chapter 3 provides an

[2] Peter Bernstein's *Against the Goods: The Remarkable Story of Risk* provides an updated narrative for many of the issues visited by Knight. Readers who are very familiar with the second half of either of those two books might want to skip ahead to part II, which covers issues not addressed in these books.

overview of the main ways in which risks (measurable uncertainties) are addressed. Risks are normally reduced through planning, behavioral rules and routines, and risk pooling. Chapter 4 reminds us that, even after the steps of chapter 3 are taken, there is a residual that remains uncontrolled, unexpected, and uninsured. Unpleasant surprises, a subset of which are true crises, remain part of the life, although individuals and organizations use a variety of strategies to manage and limit the losses from such events. Many of these steps for dealing with crises are similar to those undertaken to address measurable risks, but they nonetheless differ in significant ways.

Part II analyses the democratic politics of risk management. Some risks can only be managed through governments, others can be more cheaply managed via governments, and still others are less expensive for a majority of voters, because of the method through which risk reducing services are financed. The analysis of Part II parallels that developed in Part I. Chapter 5 notes that both voters and interest groups will attempt to induce government efforts to reduce their downside risks. The methods used, will for the most part be "larger" versions of the methods used by individuals: planning, rules, risk pooling, and reserves. Chapter 6 notes that such approaches cannot completely eliminate risks and therefore voters will demand social insurance to soften the blows of the risks that remain.

Chapter 7 reminds us that societies and their governments also face unpleasant surprises, crises that demand extraordinary--unplanned for--responses. Both crisis management and crisis insurance are instances in which unplanned for problems emerge that require immediate attention. Chapter 8 notes that new risks may be introduced by government policies. Governments, themselves, may create risks and crises as well as solve them. Indeed, constitutional government (rules) can be considered, at least in part, an effort to limit such risks. However, constitutions are limited to some extent in their ability to reduce risks associated with the delegation of authority to governments. Rules, alone, are not likely to be sufficient to avoid major crises of governance.

Parts I and II provide rational choice foundations for a broad range of risk reducing activity, with sufficient illustrations that hopefully most readers will find the analysis to be more or less obvious, indeed common sense. However, the nature of a crisis and how responding to them differs from other surprises is not obvious and rarely included in economic models. Public choice models play a role in part II by providing frameworks for analyzing the electoral demand for and the scope and likely finances of risk and crisis management programs. In general, those models predict that policies will be imperfect. They tend to be broadly effective, but mistakes can produce crises partly because of the magnitude of government activity.

Part III explores historical and statistical evidence to determine whether the theory developed in Part II can account for the emergence of the Welfare State, arguably the greatest public policy event of the twentieth century. Chapters 9 and 10 provide general historical overviews of major risk managing programs: defense, regulation, and social insurance adopted during the twentieth century. It is these that gradually produced the modern welfare state. Chapter 11 provides statistical evidence on the great expansion of social insurance programs after World War II. Chapters twelve through fourteen analyze recent instances of crisis management by governments. These demonstrate that governments, like individuals, have to deal

with unpleasant surprises, and do not always successfully minimize losses from them. These crises show that risks have not been--and cannot be--fully controlled. In many cases, governmental crises are consequences of past government policies and/or failures to revise existing policies.

Part IV summarizes the main arguments of the book, contrasts them with earlier work, and analyzes the limits of governmental risk and crisis management. This is not the first book to suggest that crisis has affected the size and scope of contemporary governance, see for example, Higgs (1989) or Moss (2002). But, it is the first to imbed the analysis in a general framework, to explore specific voter and institutional mechanisms through which this has occurred, and to have an international scope.

This book provides a new lens through which to analyze government policies. If addressing risks and uncertainties--rather than public goods or redistribution--have been the main engine of policy development and government growth in Western democracies during the twentieth century, economists and political scientist can better analyze the policy by shifting the focus of their analysis. Both the models and norms for policy need to be adjusted to take account of risks and uncertainty in both private and public life.

The "nanny state" attempts to control, ameliorate, head-off, and manage risks, rather than solve public goods and externality problems or redistribute wealth from the rich to the poor, as often argued by mainstream economists. It does so because voters are risk averse and risks are central concerns, and because the state can manage and insure a wide range of risks that individuals and private organizations cannot. In areas where risks cannot be managed or mistakes tend to be made, crises will exist--and crisis tends to both expand the domain of governance and reduce its effectiveness. To the extent that such problems are partly consequences of excessive demands for governmental crisis management induced by misperceptions of risks or the risk-managing abilities of governments, this volume may help reduce such problems by reminding readers that not all risks can be managed.

Chapter 2: The Centrality of Risk and Uncertainty in Human Life

> The best laid schemes of mice and men go often awry, and leave us nothing but grief and pain, for promised joy! (R. Burns, 1785)

> On broad grounds of common experience and common sense we may well be inclined to start by saying that we all know that there is such a thing as a feeling of surprise, we have all experienced it at one time or another, and it would be absurd to say to oneself at any stage of life: 'I shall never again be surprised.' GLS Shackle (1953)

A. Introduction: Equilibrium, Surprise, and Adaptation

An ordinary day is ordinary, because nothing out of the ordinary happens. During such days, we confront choice settings that we are familiar with and our standing routines lead us to choices and actions that serve us well in those settings. This "ordinary" aspect of life may be thought of as an equilibrium, both in the philosophical sense of reflective equilibrium with respect to plans and routines, and in the economic sense of expected utility maximizing choices.

A "bad day," in contrast, our equilibria are disrupted. On such days, our standing routines fail to deliver their usually good, or at least acceptable results. The circumstances evidently differ from our usual ones, or our plans were not as reliable as we had imagined. The failures of our standing routines causes us to reconsider our plans. Such efforts are evidence of reflective disequilibrium and, if we change our plans, of failures to maximize expected utility.

Such "bad" days are left out of most economic and other rational choice based research, either because other authors believe them to be relatively infrequent or because they believe that nothing general can be said about them. Bad days may be regarded as the froth of ordinary life, the unavoidable "error term" of forward looking decisionmaking. This chapter suggests that "bad" days are sufficiently commonplace and have sufficiently generalizable properties that they are worthy of study. Indeed, it suggests that to analyze ordinary life and public policy without them is to miss much that is important about each.

This is not because every day is filled with crises, although minor crises are commonplace. It is because we are constantly dealing with choice settings in which many things are unpredictable or unknown. We live lives which are less predictable than most of the models used by social scientists suggest, but in which many of the events we need to respond to are familiar. As a consequence, much of "ordinary" life consists of standing routines for coping with random events, both favorable and unfavorable. Our plans do not ignore risk and uncertainty, but are driven by them.

The sun rises every day at a different time, so rather than rise with the sun, we use a clock, which can be used generate a standardized, certain, day. Rather than risk poor teeth and illness, we start our days with the particular steps of hygiene and repast. Because the weather changes every day (indeed every hour) in many parts of the world, some information about the day's weather is gathered, so that we can adjust our attire for the rain, wind , or cold. The weather changes hour by hour and season by season. We climb into our vehicles and buckle our seat belts to

reduce risks from accidents and the poor driving of others. Our daily routines can be said to consist mainly of risk reducing responses to common circumstances.

Our standing routines, nonetheless, occasionally fail. A child may unexpectedly win a prize or be taken ill, or a colleague may be in an exuberant or irascible mood. We may unexpectedly find a missing tool or run out of coffee or milk. A close friend or colleague may come to visit or be hurt in a traffic accident and need assistance. On those days, our routines may be adjusted in new, creative ways, to profit from an unexpected opportunity or avoid unexpected losses.

When our standing routines work tolerably well, we do not often reflect on how those routines might be improved. Such efforts require the use of scarce time and attention, which is constantly in demand. Revisiting old decisions is not always, or usually, the best use of those private resources. On bad days the outcomes are worse than average or unacceptable and the rewards of further thought possibly sufficient to reexamine our routines (strategies) for coping with the events experienced. Our reflective equilibrium has been disturbed.

In some cases, no method of improving them is evident, in others new ones may be adopted. Either case, suggests an absence of reflective equilibrium, but only the latter implies that our standing routines have failed to maximize expected or average utility.[3]

All this should seem like common sense, but behind the common sense there is a good deal that can be explored. This chapter focuses on why it is that we can have "bad days," days on which our standing plans can be said to fail, even though we are forward looking .

Rational Plans

Most economic models of decision making were developed to explain why prices at the grocery store look the way they do. For the most part they reflect supply and demand, or production costs and utility maximizing choices. Firms attempt to maximize their profits and pick production methods and outputs to do so. Consumers want to get as much value from their income as possible and so purchase the bundle of goods and services that maximizes their utility, (satisfaction or happiness). Mathematical representations of these choices allow one to characterize a consumer's ideal shopping lists. This is not a static list of the sort that one carries to the store, but rather a conditional "list" (a series of demand functions) that characterize how much of a variety of known products, a consumer will purchase at various prices. When prices change, the items that wind up in the shopping cart change, because our demand functions call for purchasing different combinations of goods and services.

Rational choice models are not, however, limited to characterizing shopping lists. The same rational choice approach can be used to characterize human

[3] Hayek (1937) provides a very nice account of the link between knowledge and plans of action, which is one reason to adopt the word "plan" to characterize a series of conditional responses worked out in anticipation of possible external events. An alternative to the term "plan" would be the term "conditional strategy" from game theory. Such strategies (or best-reply functions) characterize how one should responds to the actions of other players to maximize one's (risk adjusted) payoffs from the game, given a knowlege set. I use the terms standing plan, strategy, and routines in an essentially interchangeable manner in the text to reduce redundancy.

behavior in a variety of non-market contexts, in contests, in governments, in church, etc.. If people optimize in those other environments, they still want to get the most utility that they can, given their resources. And, will still be the case, that the best strategies depend partly on circumstances beyond their control. The best plan of action specifies the optimal response to every event that one anticipates. In mathematical terms, if x, y, and z are commonplace random events, such as temperature, humidity, and precipitation. The effects of these variables on a person's welfare (well being, or utility) may be characterized with a utility function over actions, a, b, c, for given values of x, y, and z, as with $U = u(a, b, c \mid x, y, z)$. If response function or routine maximizes utility for the values of x, y, and z that are ordinarily confronted, then it will serve Al well as a standing routine for coping with changes in x, y, and z through time. Mathematically, there may be a separate response variable for each of the control variables, a, b, c., as with $a^* = r^a(x, y, z)$, $b^* = r^b(x, y, z)$, and $c^* = r^c(x, y, z)$.

However, if unknown variable "v" changes, such routines may fail to maximize personal welfare. In such cases, the standing routines should be augmented to include "v", or at least the response function will have to be recalibrated to reflect the new circumstances. Not every day or event is an ordinary one. Similarly, if the response functions were ideal for only a subset of the values that x, y, and z could take, experiencing new values of known variables may also cause plans to be adjusted.

Some unusual events are easily recognized and responded to because they are similar, if not identical, to events experienced in the past. In a subset of such cases, standing routines, and plans may have to be quickly revised or entirely new ones devised to limil losses.

Minor surprises may call for an emergency run to the grocery store or bank, major ones to a hospital or court. Similarly a pleasant surprise may also call for quick responses, as the saying goes, "when opportunity knocks, open the door." However, some cases, there may be no response, because the new circumstance is unrecognized or because no obvious response is possible. Supper may be served while Vesuvius erupts. The greater or more frequent the surprises are, the larger the revisions tend to be.

The Importance of Unpleasant Surprises

Reflection, direct observation, and contemporary psychology suggest that it is the unpleasant surprises, rather than pleasant ones, that attract the most attention. That unpleasant surprises concern us more than pleasant ones may reflect evolutionary pressures, insofar as survival is more often threatened by failures to properly respond to unpleasant surprises than pleasant ones. Quickly responding to a flood, forest fire, or attack is normally more important than running, rather than walking, to a fine apple orchard, mountain spring, or friend. That is to say, our natural loss functions are asymmetric. A loss of amount X is of greater concern than a gain of the same amount.

The private significance of unpleasant surprises depends on how frequently they are encountered. If they are rare, then our personal plans and routines need not take much account of them. If they are frequent, our plans will incorporate greater flexibility than otherwise would be optimal. The plans adopted will be

relatively more easily adjusted than would otherwise make sense. We hesitate to accept even very favorable looking long term commitments.

The significance of such behavior for social science would be minor if unplanned for events are rare. In such cases, surprises may be considered "exogenous events" outside the model of interest and ignored without very much loss. If on the other hand, unplanned for events are relatively frequent our one-choice models of rational behavior will mislead us both about the nature of the plans (conditional strategies, response functions) adopted by individuals and organizations.

If surprises are commonplace, the one-choice model will not serve us as well either as a method of representing the actions that we observe, the states of mind that lead to their adoption, nor the nature of the plans adopted.[4] Much that could be explained will be left out of our models, and much that is "explained" will be false or misleading.

This chapter suggests that surprises are commonplace and that responses to them are sufficiently predictable to be worthy of analysis.

B. Natural Risks

Subjectivism is an essential part of human experience. In our minds, we can be and in many senses are self-sufficient, and a reflective equilibrium often exists. One may be completely content with one's knowledge and routines. Our thoughts may reach a state in which no change seems, or is, necessary. Subjective nirvana is possible.

However, physical reality often intrudes. Our physical bodies are neither self-sufficient, nor can they be completely in equilibrium. Food and water are required to continue in existence, whether in good health or bad. We need a bit of sleep to recuperate from our daily efforts. In most climates, we also need shelter from foul weather. We need to dispose of our waste products. Beyond the necessities of individual life, survivorship of humankind requires reproduction and support for the next generation, because we are all gradually dying. Thus, both sex and the caring for children can be added to the list of physical necessities.

Because the external world is not entirely predictable, a variety of surprises are confronted every day, although those risk vary through time and with the state of knowledge and organization. Our success at coping with many natural risks allows us to forget how many of our choices are directly or indirectly influenced by them, but it does not imply that we have succeeded in routinizing all of life.

Weather provides an illustration of how individuals tend to take account of normal variation and also how an unusual event can cause plans to fail. Weather away from the equator varies substantially by day, season, and year. Within what might be called the usual range, we educe losses by investing in capital goods that

[4] The standard lifetime expected utility models are one-choice models insofar as an individual adopts a plan for life and simply implements it during his lifetime. Revisions to that initial choice are not contemplated, although how changes in circumstances will be adapted to are. For example, an increase in price will generally cause a lifetime planner to reduce his consumption of the more expensive good. His demand functions summarize part of his plan. The comparative static results of optimization models characterize existing plans or response functions rather than revisions to existing plans. Multiple decision days such as those characterized in this paragraph are not captured in standard rational choice models.

can shield us from losses associated with extremes. Contemporary houses have furnaces and air conditioners, in addition to their water proof and windproof skins. Our wardrobes includes coats, sweaters, boots, umbrellas, sandals, shorts and t-shirts. We have routines for switching the heat on for the winter and the air conditioning on for the summer, and for carrying umbrellas and coats, or not, according to the risk of rain. Those routines can fail when the weather takes a turn to rare extremes--a hot day in winter, a bitter cold day in summer, an unusually stormy day, a hundred-year flood. On such days, our normal efforts to limit losses fail, and new steps--often entirely new--must be undertaken. One's standing plans for dealing with weather may also fail when their choice setting changes, as when one moves from one climate to another. Here one may imagine the wardrobe changes that a Swede moving from Stockholm to Cairo, or an Egyptian moving from Giza to Goteborg would "have to" undertake. Without our protective stocks of capital goods and routines, weather would pose non-trivial risks in most of the territories presently occupied by humans.

Other natural physical risks are ecological in nature. We are all food (sustenance) for something else on the planet. Humans are near the top of nature's food chain, but risks from other large carnivores have long existed and still exist in wilderness areas. Lions, tigers, and bears are large and strong enough to consider a child or full grown man a possible dinner. In addition, a wide assortment of fungi, microbes, and viruses find us to be useful sources of sustenance, whether we are alive or dead. The common cold and many other microbes rely on us for transportation and reproduction. Microbial uses of human life systems often undermine those systems, leading to illness and death of their hosts.

As in the case of past efforts to reduce the impact of bad weather, the success of our ancestors have reduced these ecological risks as well. The population of large animals that can pose threats to humans has diminished enormously from hunting. Most of the large animals that remain hesitate to think of humans as lunch, because of the risks associated. During the past two centuries, advances in medicine have also reduced risks from microscopic predators, with improved sanitation, vaccines, and antibiotics. However, success against the small are less complete than against the large predators. Many energy sapping and life threatening diseases remain uncontrolled. Several diseases thought to be under control have evolved in a manner to promote their own survival prospects, as with antibiotic resistant strains of pneumonia, streptococcus and meningitis.[5]

In addition to risks associated with being another specie's lunch, there are risks associated with finding lunch. Neither hunters nor gatherers always succeed in doing so. Hunters may fail to chance upon suitable food sources or simply make mistakes in their efforts to bag the animals of interest. Gatherers may fail to find sufficient edible plants, may over harvest that which can provide sustenance, or may harvest plants or parts of plants that are not food.

Again strategies for reducing the risk of starvation were developed, as hunting methods improved and especially with the development of animal husbandry and

[5] See the Center for Disease Control (CDC) website for a list of antibiotic resistant diseases (http://www.cdc.gov/drugresistance/diseasesconnectedar.html). The World Health Organization estimates that in 2010, about 1.8 million persons died from HIV induced causes. (See http://www.who.int/gho/hiv/en/index.html .)

horticulture--e.g. farming. These solutions did not eliminate all risks, but did assure more reliable and plentiful supplies of food. The world's farmers support a far larger population of non-farmers than hunter-gatherers ever could. Nonetheless, while diminished, the risk of hunger and famine did not entirely disappear. Crops at a given locale may fail for a variety of reasons. The weather may be poor, insects may eat the desired part of the plants, a variety of microbes may undermine the viability of the plants as a whole. These risks in turn were reduced through the organization of agricultural markets that allow areas suffering from (short term) crop failures to import food from other areas with better growing conditions.

All of these efforts to mitigate physical risks had major effects on the food, clothing, home construction, and medical industries. Even modern macro economists attempt to cope with the weather through various efforts to construct seasonally corrected data sets, yet risk is rarely mentioned in economic textbooks, except, perhaps, in a chapter near the end.

This is not because all such risks have disappeared from contemporary life. Although technological and organizational progress have reduced a broad range of natural risks, especially for those living in the wealthier parts of the world, natural risks remain. Nearly every year, a few great storms and floods threaten millions of lives and billions of dollars of capital. New, potentially, life threatening diseases emerge every few years. And, farm output varies year by year as weather and disease varies through time.

Enormous progress has been made, but even the most basic of risks have not been fully managed.

C. Social Risks: Conflict and Externalities within Communities

In addition to what the above natural or physical risks, there are a wide variety of social risks that individuals face.

Many of the advantages life in communities have to do with risk-management methods that are available to groups, but not to individuals, such as risk pooling and rule enforcement as developed later in the book. However, along with the benefits of community life, a variety of new risks also come to fore.

The same competition for resources that takes place in nature within and among species also occurs among humans who live in close proximity to one another in communities. A wide variety of risks associated with life in communities arise from conflicts over scarce resources. Although a subset of these competitive contests--as with parlor games and sports--are undertaken for personal enjoyment, many others are contests in which substantial losses are unwillingly borne by losers. Examples include warfare, commerce, romance, and a variety of status games. Such unfortunate games often produce tragedies, in fact as well as in fiction.

In some cases, the loses associated with specific contests are completely predictable. In many others, the losses arise through processes and are not fully predictable. The strategies of other players may be explicitly random. Innovations in strategy may disrupt old equilibria modes of participation. The mix of players in the contest--who may differ by skill, risk aversion or norms, may also alter the outcomes. The rules of the game itself change through time in a manner that is not entirely predictable or which unexpectedly create new dilemmas. A variety of

unpleasant surprises may be generated by the efforts of others to advance their own interests in a social context.

These may be curtailed through various risk-reducing rules as also developed below, but such rules are not always adopted. And, moreover, a subset of social risks can not be eliminated by such rules without undermining other benefits of social life (e.g. sharing the fruits of innovation) or producing still other risks (unadaptive societies).

An Illustrating Social Dilemma

Table 2.1 illustrates the essential social dilemma, to use Tullock's phrase (1974). A social dilemma exists when persons are drawn into conflict in a manner that is counterproductive for all the parties involved. The payoffs of 2.1 provide a simple static representation of the incentives faced by the persons in a social conflict, if the attack and produce options are interpreted broadly. Under the payoffs implied by the rules (or lack of them), each player will attack the other, which generates a Nash equilibrium in which each receives a smaller payoff than would have been achieved without he conflict ([2, 2] < [6,6]), but larger than if the had simply ignored the other's attack ([2} > [1]).[6]

Table 2.1: The Social Dilemma: Conflict with Predictable Outcomes

Al \ Bob	Produce	½ Attack	Attack
Produce	6, 6	3, 7	0, 8
2 Unit Attack	7, 3	4 , 4	1, 5
4 Unit Attack	8, 0	5, 1	2, 2

Each participant would be better off if all players had all adopted some other strategy, the mutual but no single persons can induce a shift by him or herself. Thus, social dilemma indirectly demonstrate that the "wrong rules" can lead rational actors to perverse outcomes, by inducing or failing to block such contests.

This static contest illustrates some key features of unproductive social conflict, but the result is completely stable and predictable. The losses associated with such social contests are completely knowable once the game is underway and understood. The only uncertainty in this social context is not the play itself, but rather whether one may be "forced" into such unproductive contests or not. There are neither risks nor uncertainties in such contests once they are created.

Table 2.2 below characterizes a similar game setting, in which a new strategy is developed, namely defense. This innovation, as characterized, undermines the equilibrium in the social dilemma. As in the game above, each player is assumed to have 6 units of the all-purpose resource (perhaps time and attention) that can be used for three purposes. The payoffs assume that production allows all the available resources (6, 6) to be used in a manner that generates utility or

[6] Three by three games allow a continuum of strategy types to be illustrated without the use of calculus. Both games can be easily generalized by characterizing continuous strategies and assuming larger numbers of players.

satisfaction. Defense has an opportunity cost of 3 units and reduces the damages from attacks, but does not eliminate them. Attacks consume 4 units of the resource, as at the Nash equilibrium of Table 2.1.

Table 2.2: Conflict with Unpredictable Outcomes

A \ B	B:Produce	B: Attack	B: Defend
A: Produce	6, 6	0, 8	6, 4
A: Attack	8, 0	2, 2	3, 3
A: Defend	4, 6	3, 3	4, 4

This game does not have an equilibrium in pure strategies. Note that the (produce, produce) cell yields that highest total payoff; but each player can do better by launching an attack against the other, as in the previous game. However, anticipating that the other player is likely to attack, each player may choose to defend him or her self, since that outcome is better than the one associated with sustaining an undefended attack (3>2). Yet if the both players engage in defense, rather than defense, each is better off devoting all his or her effort to production (6>4). The same logic would apply to small rival groups that attempt to maximize group net benefits.

What will happen is far from clear. If participants participate in the manner assumed in most game theory texts, an equilibrium in mixed strategies exists. If adopted, the players randomly select among do nothing, attack, and defend. And, consequently, each cell outcomes will occur with positive probabilities. There will be feast, standoffs, failed attacks, and conquests. The latter might end the game in somewhat more sophisticated sequential versions of the game.

Uncertainties and risks in this type of conflict setting are partly a consequence of the game itself and partly of the types of players confronted. If both players are risk neutral expected payoff maximisers as usually assumed, mixed strategies will be adopted. In such cases, each of the three strategies are used with roughly equal in probability, more or less as in children do in the widely played "paper, scissors, stone" game.[7] As a result, the conscious choices of each participant produces risks for the other. Both the observed outcomes and payoffs are purposely, but, randomly generated.

A variety of other outcomes are possible according the risk aversion, norms, and information of the players involved in the game. If he players maximize their lowest payoff, rather than their average payoff, each would choose defense as a strategy. Its guarantees a payoff of three, which is greater than the worst cases associated with attack (2) and production (0). When this game is played among maximin players, (defend, defend) would be the equilibrium of the game.

[7] The actual probabilities would be (12/36, 13/36, 11/36) in the standard mixed-strategy equilibrium, roughly a third each. Heiner (1983) has argued that mixed strategy equilibria are so commonplace that the only reason we observe predictable behavior is because of the computing (time and attention) limitations of those making choices.

In other cases, the strategies themselves may be valued independently of economic aspects of the outcome (the material payoffs). For example, the (attack attack) cell may be an equilibrium if warrior values are internalized by the players or rewarded by social status. "Warriors" may prefer attack to defense because it produces non-economic benefits such opportunities to demonstrate bravery, which are judged sufficient to offset the resource cost of the outcomes. Pacifists might support inaction over the other more violent strategies, regardless of the economic consequences. In this manner, slight modifications of the two games can be used to illustrate how risk preferences, norms, and culture affect behavior and the extent of risk and uncertainty associated with a given social dilemma.[8]

The point of this illustration is not the one that I often make, that resources are wasted in conflict, but rather that conflict settings often emerge in social settings and may involve strategy choices that create risks and uncertainties for other participants. In many social settings, including large scale ones, both surprise and random are intentionally produced by rivals for scarce resources, because that uncertainty has a beneficial effect on the outcomes. Lidell Hart (1991), for example, provides numerous historical examples of the importance of intentional surprise in settings of armed conflict.

Taken together, the two game settings can also be used to illustrate the effect of different kinds of innovations. For example, suppose that the initial setting supports a "produce, produce" equilibrium. (This would be the case if attacks consume 6 rather than 4 units of the all purpose good.) As the cost of attacking falls, the equilibrium would shift from (6, 6) to (2,2). And, as cost-effective defenses are developed, defensive measure would be adopted that improve the average outcome, but in which anything could happen.

Innovation can change the nature of choice settings in a manner that does not always improve outcomes nor diminish risks. Moreover, the possibility of innovation implies that each social choice setting is a bit uncertain, because existing equilibria may be disrupted by new strategies or new types of players. Such innovations will require that participants adjust their strategies to avoid significant losses; however determining the best response is not always possible--whch is often the main benefit of surprise attacks for those launching the attack.

The Broad Domain of Social Conflict and Surprise

The above contest can be used to illustrate wide range of social contests by interpreting "produce," "attack," and "defense" strategies in nonmilitary terms. For example, in status contests—keeping up with the Jones—an equilibrium level of conspicuous consumption may be disrupted by a major expenditure of one's neighbor (a new car, a new garden, swimming pool etc), the impact of which may be countered by other expenditures various ways. In many occupations, salaries vary among persons performing similar tasks, and again there are often advantages that can be realized through various aggressive and defensive strategies (buttering

[8] The payoff matrices can be adjusted to reflect warrior and pacifist norms by adding amount W or amount P from the attacker's payoffs. $W > 1$ is sufficient to generate warrior equilibrium. $P < -2$ is sufficient to cause the attack strategy to be retired from use.

up the boss, dressing for success, working late and/or early hours, etc.).[9] In democratic politics, attack ads by rival candidates may be run or not, defended against or not. In economics, new products and advertising themes by rival firms may be countered through defensive ones or attack ads, and so forth.

D. Unintended Consequences

In addition to intentional risks and surprises that emerge from conflict over scarce natural and social resources, there are also unintentional risks associated with life in communities. Along with unintentional benefits of the Adam Smith "invisible hand" variety, there are of unintentional mistakes, accidents, and externalities, many of which produce both new risks and unpleasant surprises.

Consider, for example, the effects of accidents. Accidents are unintentional consequences of actions undertaken with the aim of producing one result, when, instead another less desirable outcome occurs. Most accidents are predictable in the sense that the possibility is understood prior to the action. However, the action, itself, does not map one to one into particular outcomes, but probabilistically into a serious out outcomes. Most not entirely intentional results have the property that their likelihood can be reduced by exercising "care" in various ways. That is to say, the probability function linking a particular action to a probability function over outcomes is conditioned on more than one control variable. In many cases, care is simply focusing time and attention on the actions that generate the consequences of interest. When one walks down a street, accidents are more likely to happen when ones attention is focused on something other than the ground upon which one is walking. While otherwise occupied, a gap or bump in the sidewalk may cause one's standard step to miss-land, resulting in a trip or fall, rather than forward progress. Looking both ways before crossing reduces, although it cannot eliminate the probability of accidents: an unnoticed driver may run a red-light or turn the corner too quickly to be avoided.

Losses associated with accidents can be significant. When one falls, bones may break, and one may be less able to engage in physical activities required for survival for weeks or months at a time. In the period before antibiotics were developed, even scrapes and scratches could produce life threatening infections. In extreme cases, death may still result directly from the accident, as when one loses control of an automobile and crashes into a tree.

Unfortunately, there is a limit to the amount of care that can be exercised because we have only so much attention available at a given time, and when some or all of that attention is diverted to other purposes, accidents become more likely. One's capacity for multitasking (stock of attention) varies from day-to-day in a more or less random fashion. If the number of tasks one divides attention among is more or less constant, one's personal accident and error rates will vary substantially through time. Even if a person is completely rational and always forward looking, unexpected short falls in attention will produce a variety of unintended consequences in complex, dynamic, circumstances. Expert tennis

[9] Economic analysis of conflict within positional goods, relative income, and status games began with Hirsch (1978) and Frank (1987). See Congleton (1989) for an analysis of how status games tend to change through time in a manner that tends to reduce losses in the long run. See Binmore (2005) for a discussion of the wide applicability of game theory to life in society.

players will hit an "easy" shot into the net or out of the court. Expert speakers may drop or slur words, and tired executives may over react to minor problems or under react to major ones.

To economize on time and attention, individuals and groups often adopt a variety of rules of thumb that can substitute for care. "Cross only on green lights," may be substituted for "look both ways and cross." The former works well in most cases and allows attention to be focused on other matters when crossing--even though the other rule may reduce travel times and the probability of accidents relative to that rule, when carefully applied.

Within communities, one person's accident or mistake often affects persons other than him or her self. A slip on a sidewalk may knock another down. One sick person may infect another. A bit o careless riding or driving may threaten or kill pedestrians and fellow drivers. The inattention of operators of complex equipment at refineries or nuclear power plants may cause accidents that threaten the lives of millions.

The level of "care" or "due diligence" by a person or small group decreases the likelihood that an accident occurs. Similarly, rules of thumb may be employed to reduce the probability of accidents. And, as such rules proliferate to address the wide variety of risks inherent in community life, due diligence may have less to do with actions that directly affect the probability of an accident and more to do with carefully following a complex array of rules of thumb than with direct assessment of risk and rewards.

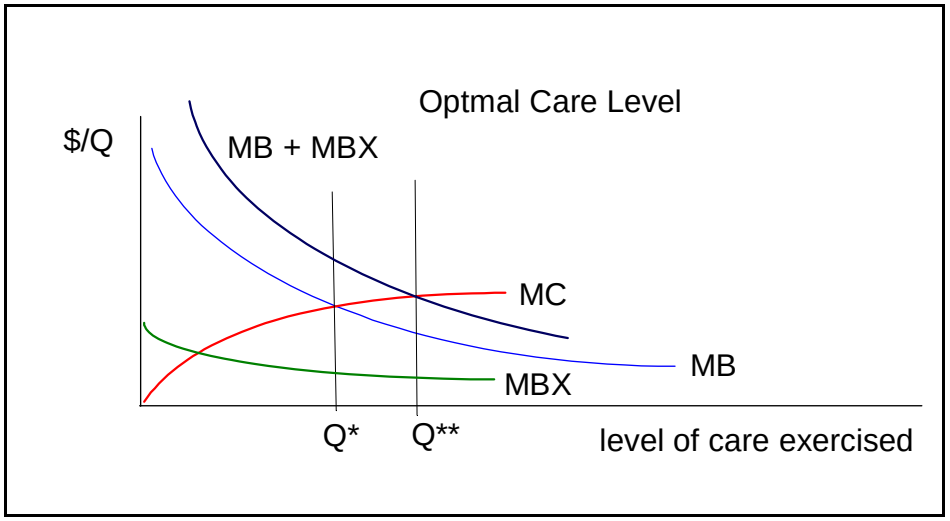
On the Under Provision of Care: Externalities from Exercising Care

Unfortunately, exercising care to reduce the losses borne by others is not an entirely natural form of behavior. The costs are borne by the person(s) exercising care, and the benefits realized by those who are now less likely to suffer losses. This suggest that care will be under-exercised by persons who live in a "spontaneous" (ungoverned) community and accidents more frequent than would advance the average interests of those living in the community.

The figure below illustrates the moral hazard or externality) problem associated with a person's choice of care in a setting in which care reduces average losses for others. In the absence of social or governmental sanctions, the chooser will be more interested in his, her, or their own expected net benefits, than the losses of other. For convenience, let us call the decision maker Al and characterize his choice using private (expected) MB and MC curves. Al's privately optimal level of care is that labeled Q*.

There are "spillover" benefits from Al's care (reduced expected marginal damages on others) and an associate externality problem. The level that maximizes net benefits for the community as a whole is a bit larger than that which maximizes Al's expected net benefits, because that level takes account of spillover benefits generated by Al's care. The (utilitarian) socially ideal level of care is labeled Q**. Clearly, from a utilitarian perspective, care is under provided, $Q^* < Q^{**}$. There are "external" benefits from care that are not taken account of by the person that controls the level of care. The lack of appropriate care ($Q^{**} - Q^* > 0$),

consequently, may be regarded as an externality problem from the point of view of mainstream public economics.



However, this standard characterization of a moral hazard or externality problem is not the main point of the present discussion. The main point here is that life in communities places one at risk from the carelessness of others in the community. As a consequence members of a community will have reasons to encourage greater care among its members. This level of care may or may not be Q**, but it is very likely to be a level greater than Q*. The persons bearing those risks would like to avoid them regardless of whether they are "over" or "under" produced from the perspective of welfare economics or utilitarian social theory.

It is the presence of external damages rather than their optimality from the perspective of welfare economics that will motivate affected individuals and groups to take steps to reduce their risks.

Although welfare economics suggests that utilitarians will favor rules that encourage greater care, even non-utilitarians will prefer that such persons take greater care insofar as they are placed at risk. If those harmed are not utilitarians, they may simply encourage their fellow members to reduce risks to the lowest possible level. In this case, they would lobby for and may achieve a level of care that a utilitarian would regard to greater than optimal.

Some General Conclusions About the Risks of Community Life

A broad range of choice settings in communities involve situations in which the outcome are unpredictable both before and during the event. In some cases, the stochastic element is accidental, in others it is the result of conscious efforts by competitors to surprise one other. These uncertainties are compounded by uncertainties about the payoffs of other players, their mode of play, and possible changes in the rules and technology for participating in the contests of interest. For all these reasons and others, including surprise natural events, social life necessarily involves both risks and uncertainties.

That only a subset of these games directly involve commerce or politics does not make them irrelevant for economics or political science, because most require the use of scarce resources and in total are economically important activities that consume significant fractions of national product. And, as developed in part II, community governments may attempt to intervene in various ways to reduce risks and uncertainties associated with life in their communities. The persons trapped in such social contests will often wish to avoid the risk of loss, yet cannot easily do so by themselves.

Communities that properly regulate risks will tend to be more prosperous and attractive than ones that over or under regulate them, because more people will be attracted to them and losses associated with given population levels will be lower. Improper regulation, contrariwise, will reduce in-migration of new residents by producing less attractive communities and increase out-migration to communities that do a better job of managing such risks. Risk management is, thus, a natural area of concern for community governments.

E. Economic Uncertainties

Trading networks, like communities, also provide a wide range of benefits for those who participate in them, including reductions in some kinds of risk, as noted above with respect to agriculture.

A good deal of commercial life takes place in communities, and the discussion of risks associated with life in communities directly apply to the part of community life associated with markets. For example, there are a variety of social games played among firms that compete for customers, suppliers, and market share. Other risks are generated in a manner consistent with figure 2.1; for example, by firms that use freely circulating air and water to dispose of waste products in their efforts to reduce production costs in order to save their customers a bit of money and/or earn a bit higher profit for their shareholders. Again damages are imposed on others, not by intent, but an manner analogous to other accidental damages.

However, most market networks extend beyond communities and so risks and uncertainties associated with these broad--often worldwide--networks are worthy of separate attention. Both community and extended markets, for example, encourage specialization, insofar as income and wealth can often be increased by producing a narrow range of products or mastering a narrow range of skills. Together specialization and gains to trade allow buyers and sellers to have richer material lives, but by putting all of one's eggs in a single basket (or two), specialization also exposes one to new risks. In global markets, prices for one's products or services are often affected by random events in distant lands. Drought in the American mid-West may affect corn and meat prices in Beijing or Berlin. A new form of cell phone developed in California or Korea may diminish profits, wages, and real estate prices Finland.

There are risks, as well as benefits, associated with Adam Smith's invisible hand and Schumpeter's process of creative destruction. These risks are somewhat moderated by future markets and insurance products of various kinds, but imperfectly. At the same time that market participates obtain new opportunities to prosper, they also risk losses that they would not have confronted, but for extended trade networks.

This is partly a consequence of specialization. Trade tends to reward specialization, the narrowing of products and services produced by individuals. For example, as specialization increased in the West during the nineteenth century, the number of persons producing their own food fell from about 90 percent to about 10 percent of the population. Similar reductions occurred in the production of other necessities such as housing and clothing. Because of the productivity of specialization and organized production, one's standard of living could be increased by trading one's time and attention, often at narrow tasks, for money and using the money to purchase food, clothing, and housing.

Price and wage shocks now threatened survival in a manner that was less common in previous times, at the same time that it became easier to sustain life during normal times. Average work weeks fell and average longevity--in spite of the new risks--increased. The new market opportunities were well worth taking for most, even if they were associate with new risks, other declined. For example, bad weather in their former home towns would not longer threaten their food supplies, because food supplies from around the world were increasingly available for those with money.

Again, the point is not that there are no benefits from increased specialization, nor that specialization necessarily increases risks relative to what it replaced. It is simply that new risks are associated with that process, and also uncertainties insofar as unpleasant surprises were not always familiar to those experiencing them. The many poetic odes to bucolic life written from the eighteenth century onward are not entirely mythic tales of pre-commercial life, but also wistful efforts to imagine a "simpler life" with fewer uncertainties and downside risks. Those who moved to cities also left behind various family and community-based social insurance systems that tended to reduce risks while at home.

In addition to micro-economic shocks, there are macroeconomic risks as well. In economies in which credit plays an important role, the mistakes (mal-investments) of a handful of investment-bankers can disrupt credit flows and generate significant effects on employment and wealth for a wide range of persons not directly involved in banking or speculative investment. Such mistakes, as well as macroeconomic policy mistakes by governments impose a wide variety of market participants with unexpected losses.[10] This is not to say that credit markets do not have benefits, but it should be obvious that they also produce new risks and uncertainties for market participants.

F. Innovation, Creativity, and Uncertainty

Creativity is the processes through which new knowledge and innovations are produced. Even if "necessity is the mother of invention," necessity is not a sufficient condition for innovation to occur. Many problems (necessities) continue to be unsolved and will always be unsolved. This may be because solutions do not exist or because no spark of genius has yet seen the solution. The latter is, of course, not entirely predictable. Because if we knew enough about the solution to characterize the solution itself or a probability function describing how it would be developed, we would, in effect, have the innovation in hand--rather than be waiting for it.

As a consequence of innovations, a wide range of persons have had to learn new skills to earning a living, as their former skills became less valuable. Recall, for example, that the term "computers" used to refer to persons with great skill at arithmetic rather than machines. That career path disappeared along with slide

[10] See xxxx for a collection of essays analyzing the financial crises of 2008. See Friedman (xxxx) and Meltzer (xxxx) for catelogues of macroeconomic mistakes by the central bank of the United States over two centuries.

rules with the creation of relatively inexpensive electronic devices that could perform complex arithmetic calculations, essentially without error.[11]

Only a few unpredictable events occur routinely enough in each of our lives to be easily described probabilistically. Most people do eventually figure out how to walk, read a novel, and find a mate, but very few produce new products, new lifestyles, or new theorems--in spite of the fact that those who do so may profit from a superior understanding of the world's complex causal chains.

Innovation, as a consequence, consists largely of surprises. If one knew today what one would know in the future, it would already be known, and so would not be an innovation. A quick look at science fiction from the 40s and 50s will reveal that most computer innovations and their effects were completely unexpected.

Some innovations are so broadly useful that they are "game changers," which substantially affect choices for a very broad range of persons, whether living in communities or alone. For example, major innovations: perspective drawing, abstraction, rock and roll music affected the behavior of subsequent artists and musicians but also the manner in which consumers of art experienced their contributions. Similarly, new scientific theories may change the way a field is taught and the kinds of questions addressed as it moves forward.

In markets, major innovations—the automobile, the personal computer, the internet—may induces changes in life which affect not only the users of those and similar products, but the organization of communities and societies. The automobile transformed urban life not only for those driving and riding in them, but by changing the organization of home life and commerce. The boundaries of cities expanded into new suburbs and ex-urbs, and made personal lives more spontaneous, less tied to train schedules and train stations (which, of course, were changes induced by 19th century innovations).

The personal computer allowed sophisticated numerical calculations, record keeping, and publishing to be undertaken at home or in an office. The internet broadened access to people, and when combined with new software products such as search engines allowed a far broader range of persons to engage in both profound and mundane research. The fully connected "office" became the airplane or bus seat, a restaurant at the beach and a cabin in the woods. E-mails, as opposed to "snail mail," can be sent instantly to colleagues both down the hallway and across the ocean. And, digital communication replaced personal contacts in many spheres of life, extending trends started by earlier innovations in telegraph and telephone. To this list of mundane innovations may be added changes in military technology, geological and biological theories, economics, philosophy, norms, and the law.

All new technologies that are adopted have benefits for the adopters, but they also pose risks for others. This is true of both military and peaceful innovations. Moreover, the mere prospect innovations pose a variety of risks--risks that cannot be avoided or fully understood. Surprise is inevitable as long as new ideas and products can be introduced into the worlds trading, social, and governance networks.

[11] It is interesting to note that even computers occasionally make arithmetic errors. Wikipedia includes a short discussion of soft errors, stochastic aspects of micro electronics. http://en.wikipedia.org/wiki/Soft_error

It is often argued that an increase in the rate of innovation is largely responsible for the economic and political progress made in the past two centuries. If so, this implies that a variety of new risks associated with life in communities and participation in markets have also increased.[12]

Appendix to Chapter 2: Some Supplemental Ideas and Illustrations

The analysis of chapter 2 is grounded in a few fairly straight forward concepts and rational choice models. Rather than center the prose on models, the models are introduced to illustrate more general points. This makes the prose more linear and the argument easier to follow. For those who use routinely models, but cannot immediately imagine how one can square the prose with more or less conventional ideas of rational choice, the appendix to chapter 2 provides a few extensions and illustrates a few more cases of interest.

On the Distinction Between Rational and Natural Ignorance

That plans, just a contracts, may be incomplete in complex circumstances is directly implied by standard rational choice models, but not by the ones used most often in the literature. Plans may be incomplete even in the usual neoclassical framework if planning costs are taken into account. The likelihood of incomplete plans is greatly increased if individual remain ignorant of a variety of factors and options that would be useful to know for planning purposes.

The problem of ignorance has not been entirely neglected by economists or game theorists, but for the most part has been limited to settings of asymmetric information in which one party does not know what the other knows. Here one may note Hayek's classic pieces on knowledge (1937, 1945) and Geogesu Rogen's

[12] See, for example, Schumpeter (1942) for an early discussion of innovation and economic development. Recent work on endogenous growth emphasizes how the accumulation of knowledge and innovation can increase productivity and economic growth, as in Romer (1994), Aghion and Howitt (1997), and Bento (2013 forthcoming).

(1971) insightful work on information and entropy, as well as a large contemporary literature on asymmetric information within firms and concerning voters. For the most part, however, contemporary research retains the normal Baysian assumption that the full dimensionality of the universe is known, and that although one player may not know what the other knows, he knows what could be known. See for example, Migrom and Roberts (1986), Laffont (1994), or McLean and Postlewaite (2002).

A good deal of ignorance is not asymmetric but uniform in the sense that some missing dimensions or possibilities have never been imagined or confronted by the typical individual. No caveman knew how to build a helicopter or to create penicillin. We are born into the world knowing almost nothing. And, although our ignorance is gradually reduced by personal experience and as secondhand knowledge is imparted to us by our families, friends, teachers, and the mass media, a large penumbra of ignorance always remains.

Only part of the ignorance that remains is the result of individual decisions. Individuals are "rationally ignorant" when they realize that unknown dimensions or parameters exist, but decide not to learn anything about those unknown dimensions or parameters. Continued ignorance might be chosen for dimensions thought to be unimportant or too complex to be understood at a tolerable cost, as might be said of modern tax laws, trade regulations, most foreign languages, Chinese cooking, economics, and many scenarios that lead to unpleasant policy surprises.[13]

However, most of our ignorance remains unconsidered, a natural residual of our initial endowment that is reduced by not eliminated through education and experience.

A Few More Illustrations of Decisionmaking Under Uncertainty

The manner in which unpredictable events affect choices varies widely, as noted above. In some cases, it makes little difference, in others a small change in probabilities will cause plans to shift, because such changes affect either or both the best conditional plan and the average outcome. To illustrate how this occurs, the following three matrices are useful. In game theoretic terms, they represent games against nature.

Table 2.3
A Stochastic Phenomenon
That Affects Outcomes but not Plans

	Action A	Action B	Action C
Event X, Px = .5	2	5	5
average payoff	3	3	4.5
Event Y, Py = .5	4	1	4

Table 2.3 illustrates a case in which some phenomenon, possibly the weather, affects an individual's "payoffs" from three alternative actions or courses of action.

[13] There is a small literature on "awareness" that suggests that more of ignorance may be rational than posited here, see xxxx, but for the purposes of crisis management, the distinction between rational and natural ignorance is not essential.

For convenience, let us call the person Al. State X may be thought of as rain and state Y as sunny, or X as cold and Y as warm. What is important for the illustration is not the real counterpart, but that some event beyond Al's control affects the value (happiness, profits, outputs etc.) associated with the three alternative strategies. In the case illustrated, the stochastic nature of the phenomena turns out to affect the payoffs (the numbers in the cells), but not the sensible course of action, because strategy C always yields a payoff that is as good or better than those associated with A and B.

Note also that in this case, it doesn't matter whether X or Y is known at the time the decision is made, or simply the relative frequency (probability) of X and Y are known beforehand. action "C" dominate both A and B, regardless of whether X or Y occurs. In some cases, a bit of information (knowledge of relative frequency and payoffs) is sufficient to make decisions that maximize average payoffs. Moreover, the decision rule used to assess choices in stochastic environments is relatively unimportant in this case. Action "C" dominate both A and B, regardless of whether X or Y occurs, their relative frequency, and whether one focuses on average payoffs, the minimal payoff, or the maximum payoff. Risk assessment is not always central to choice even in stochastic environments.

Similarly, many of the "do nots" of risk reducing rules may be instances in which a single strategy (not A and not B) dominate others. In cases in which more pleasant alternatives are at issue, staying home [C] to watch the world cup may be better than going off to the mountains [A] or beach [B], regardless of whether it is hot [X] or cold [Y], rain [X] or shine [Y]. Many instances of inter-generational advice at least claim to be identifying strategies like C. Indeed, in such cases, a good son or daughter would be doing the right thing by following his or her parent's advice, even if they knew nothing of A or B.

The choices confronted by grownups, however, are not always so simple. Table 2.4 departs from this easy choice setting by modifying the payoffs associated with strategy C; C is no longer dominant, but it can be a good choice in some circumstances. Notice that this one change is sufficient to make the choice environment more information dependent and risk assessment more central to the decision reached.

Table 2.4
A Stochastic Phenomenon
That Affects Choice of Plans

	Action A	Action B	Action C
Event X, Px = .5	2	5	1
average payoff	3	3	3
Event Y, Py = .5	4	1	5

Given information of the state (X or Y) it now makes sense to choice either B or C. The payoff for B in state X is higher than that of C (5>1) and that of C is higher than that of B in state Y (again 5>1). Note that given knowledge of the state generated by the stochastic process (X or Y), Al will never choose to engage in strategy A, which is not the best strategy in either state.

However, if a decision has to be made without knowing which state will occur (or has occurred), then strategy A has some attraction. It generates the same average payoff (3) as the others, but has a better worse-case result. A maximin player would therefore choose A over B and C, if choices have to be made without knowledge of the state. If Al is simply risk averse, rather than a maximin player, he

would also choose A over B and C, because for risk averse players losses weigh more heavily than gains. Diminishing marginal utility implies that {.5 [u(4)] + [.5[u(2)]} > {.5[u(5)] + .5[u(1)]}. Moreover, if the outcome in this setting influences outcomes in other settings--not simply subjective utility--even pragmatic risk-neutral players will prefer A to B. So strategy A, which in a full information state would never be chosen becomes commonplace, if information about the state of the world is not available beforehand and players worry about risk. In contrast, a risk neutral player would be indifferent among the three strategies. Both informational problems and risk assessments matter in this setting.

Table 2.5 illustrates the effect of a small change in the relative frequency of the two events upon which plans are conditioned. Note that with full information about which state obtains, Al's plans would not be affected. He or she would choose B if X occurs and C if Y occurs. However, if choices are made with knowledge of the relative frequency of X and Y, rather than specific conditions, plans may well change. Action B becomes relatively more appealing than it was in table 3.2. On average it has a higher average payoff than the other two (3.4 > 2.6), and has the highest payoff in the most likely state of the world to obtain (X).

Table 2.5
A Small Shift in Relative Frequency May Affect Both Average Outcomes and Plans

	Action A	Action B	Action C
Event X, Px = .6	2	5	1
average payoff	2.6	3.4	2.6
Event Y, Py = .4	4	1	5

A minimax player would still prefer action A, over B, but would find his or her self often obtaining relatively unfavorable payoffs (2) relative to those available under plan B. In contrast, a merely risk averse player might be willing to tolerate a bit of risk to obtain the higher average returns. Even with diminisihing marginal utility, there are many utility functions under which: {.6[u(5)] + .4[u(1)]} > {.6 [u(2)] + [.4[u(6)]}. Both philosophers and statisticians disagree about the best way to compare alternative strategies when relative frequencies are known, because assumptions about risk aversion differ. That such difference occur suggests that ordinary persons may differ about this as well.

These results can be generalized mathematically, but the point of interest here is not the mathematical one, but the practical one that risk and small changes in risk often affect choices at both the local and conceptual level. Moreover, risk assessment itself often matters.

The matrices also help to illustrate the role of knowledge in planning and how changes in knowledge can affect plans. In tables 2.3 and 2.4, knowing which state one was in, allowed Al to dispense with plan A and simply adopt the best response for X or Y. However, an undetected shift from the setting in table 2.3 to the one in 2.4. would leave players using the wrong strategy--course of action A would be over used by all but the most risk averse players. The matrices also illustrate how relative frequency can affect an individual's course of action. That the relative frequencies of X and Y added up to 1 imply that only those events could occur. However, essentially the same logic may occur if a third event Z occasionally occurred, especially if Z was rare and did not have dire consequences (payoffs less than 1). Indeed, given limited time and attention, Z might well be ignored for

day-to-day planning. However, if Z had unusually high or low payoffs associated with it, it might still relevant for planning and for choosing courses of action.

Chapter 3: Personal Risk Management: Research, Precautions, and Insurance

> The trade of insurance gives great security to the fortunes of private people, and by dividing among a great many that loss which would ruin an individual, makes it fall light and easy upon the whole society. (Adam Smith, *Wealth of Nations*, 1776, Book V, Chapter I, Part III.)

> It is in general not enough that the insurer who takes the "risk" of a large number of cases be able to predict his aggregate losses with sufficient accuracy to quote premiums which will keep his business solvent while at the same time imposing a burden on the insurer which is not too large a fraction of his contingent loss. In addition he must be able to present a fairly plausible contention that the particular insured is contributing to the total fund out of which losses are paid as they accrue in an amount corresponding reasonably well with his real probability of loss; i.e., that he is bearing his fair share of the burden. (Frank Knight, 1921, *Risk Uncertainty and Profit*, Part III Chapter 8.)

A. Managing Risks as a Central Focus of Choice

That life is filled with uncertainties does not mean that rational choices are impossible, it simply mean that forward looking individuals will take risk and uncertainty into account when making their plans. Losses from unpleasant surprises can be moderated. Risks and uncertainties in ordinary life, are not ignored as they are in many micro-economic models; rather they induce a broad range of responses to mitigate the losses associated with them.

Risk management is central to life, although its success can reduce risks to minor ones along the edges of life. This chapter explores the methods through which risks are managed by individuals, small groups, and markets. The success of these efforts produce much of the predictable sphere of life that we take for granted as "normal life." Knowledge is accumulated and distributed about the risks confronted. This allows use to eliminate a variety of risks and helps us to develop a variety of loss-reducing methods for the risks that remain. For example, risk reducing capital goods, hard hats and the like, may be worn. For the risks that still remain, private insurance of various kinds may be purchased.

In part II, same sorts of factors may induce voters to demand risk and crisis management services from their governments: both at the margins where unmanaged private risks remain, and in cases in which governments appear to be able to manage risks or address crises at lower costs (for voters) than private methods allow. This chapter focuses on private efforts to limit or eliminate losses associated with ignorance and truly random events.

B. Reducing Uncertainty through Knowledge Accumulation and Transmission

Many of the causal chains that we confront are complex and not immediately obvious. In some cases, complexity can be reduce by a few principles to simple controllable phenomena, as might be said of fires in a fireplace or wood stoves. In others, complexity is impenetrable, at least for long periods of time, as might be said of disease transmission in former times and of cancer in the present. Even lifetimes of focused research may fail to prevent the common cold, cancer, or predicting next month's weather.

Nonetheless, both study and analysis and trial and error cam sjeed a good deal of light on the risks that we confront and the processes that generate them. Both allow the world's risks to be catalogued and an increasing subset of them to be avoided.

Trial and error operates both biologically and socialially to reduce risks. Species that do not successfully address recurrent, life-threatening, risks do not survive. Successful strategies include high birthrates, healing system, camouflage coloring, nervous systems, mobility eyes, brains, etc.. We and other species have evolved to cope with a wide variety of losses from deterministic and non-deterministic processes. That risks change through time or from place to place implies that mobility and the abilities to detect and respond to new risks in manners that are not entirely "hard-wired" add to survival prospects, other things being equal.

In humans, because of their relatively low birthrate and long childhood, the ability to analyze ones surroundings and creatively respond are especially important. Language and memory, in turn, allow methods of coping with one's local environment to be accumulated and transferred to others in the community and to children, reducing the losses for successive generations in a manner that contributes to survival and extension of the human demain. Language and memory, thus magnify the advantages of the ability of creative response to new phenomena.

This is, of course, partially why children and young adults in the contemporary West are subjected to organized educational regimes that consume roughly a fourth of their lives. This education passes on a subset of the accumulated knowledge about how the physical and social world operates, which allows the next generation to avoid various kinds of risks linked to ignorance, and to make more productive and enjoyable use of their time and attention. The fact that more is being learned all the time implies that this education is always incomplete and behind. And, evidently, there is much more to be learned before reaching the limits of what usefully can be known, given the available aggregate levels of time and attention.

Uncertainties Regarding Completely Causal Chains

Before routines of dealing with such risks are worked out, or the relevant causal chains are understood, a variety of uncertainties exist, because of the range of alternative hypotheses that must be entertained. Each hypothesis may require different behavior to mitigate risks.

For example, some parts of otherwise edible plants are poisonous, and being able to select the good from the bad is not always possible given our senses of taste, smell, and color. Wild potatoes include toxic compounds that can be reduced through cooking to unthreatening levels. However, this fact is not self-evident. One might simply reject potatoes as a food because their toxins make some people ill. Contrariwise, since green potatoes are a bit more poisonous than mature ones, it might be concluded that potatoes are poisonous during particular seasons, so they should be harvested only in the fall. The poisons are also somewhat more concentrated in the skins. A plausible hypothesis might be that the problem is a poisonous fungi or dirt that can be washed off. Discovery of the true risk and its solution increases one's food supplies, but getting it wrong increases the likelihood

of illness and death. Even today, controversies about potatoes, and the most healthful foods in general, are rife, because of a variety of causal uncertainties.

When one does not fully understand a phenomenon, efforts to control or manipulate tend to generate accidents and unpleasant surprises Mistaken or incomplete theories of causality implies that the link between action and result is, at best, only loosely understood. Prior to the theory of germ transmission of disease, a bewildering range of risk increasing treatments for disease and for public sanitation were in use.[14] The use of rubber gloves and disposable syringes by hospital personnel to break the chain of germ transmission among patients is a relatively recent solution. Prior to that and other sanitation efforts, hospitals which were created to treat disease were often an important method of spreading disease. There death traps.

Moreover, even complete knowledge of a predictable, phenomena may not allow one to control it. We cannot control the light output of the Sun although we have a fairly good understanding of how it is produced and why it varies. We understand a good deal about weather, geology, and stock markets, but we have not yet been able to avoid relatively frequent hurricanes, earthquakes, or financial panics.

Once a risk generating process is understood, the solutions often require innovations in essentially unrelated fields. Roofs reduces how wet one is likely to get for a wide range of rainfalls. Yet unless one can use this rain-avoiding method when walking through forests or town unless a roof can be reduced to a convenient portable size. The umbrella does so, but collapsible unbrellas were evidently invented and mass produced well after the roof. Similarly, the use of latex gloves in hospitals as part of efforts to reduce the transmission of disease required unrelated innovations in manufacturing and elastomer chemistry.

Once causal chains are understood and solutions are worked out, they can be taught to others and transmitted to the next generation through formal and informal education systems. A very broad range of risks have been eliminated or reduced through this method.

However, there are limits on the extent to which knowledge accumulation and transmission can eliminate risks. Not only are there limits to time and attention, but not all phenomena can be controlled or predicted. Some risks and uncertainties always remain.

Risky and Uncertain Phenomena

In cases in which stochastic elements play a role, risks and uncertainties of the Knightian variety may have to be incorporated into theories in addition to notions of causality. In stochastic phenomena, there may be no causal mechanism, strictly speaking, but the probability of particular outcomes may be controlled. If so, knowledge of conditioning relationships allows losses to be reduced insofar as the probabilities or frequency of losses can be reduced.[15]

[14] See Troesken (1999, 2004) for interesting discussion of public sanitation, politics, mistakes, and improvements during the 19th century in the United States.

[15] Here it bears noting that at least until the scientific method was worked out in the nineteenth century, trials were relatively few and errors were relatively large. Thus progress at risk management was slow and errors were many. Nonetheless very sophisticated methods of risk management were often worked out. See for example the pre-industrial methods for managing local economic and ecological developments mentioned by Diamond (2004).

Some unpredictable events such as coin tosses have patterns that are relatively easy to understand and may be described probabilistically once the range of events and their relative frequency are understood. In such cases, a complete understanding of a probabilistic phenomena does not allow one to fully predict or control the phenomena of interest, as those rolling dice in the worlds casinos repeatedly learn. If probabilistic phenomena exist, one cannot avoid all risks.

Weather, for example, may not only be extraordinarily complex, but may be partly a random phenomena driven by stochastic gas molecular mechanics. In an affront to Einstein, god may well "play with dice." There may be truly probabilistic phenomena in the universe, as many physicists regard quantum mechanics.

.Other unpredictable phenomena do not lend themselves to probabilistic (frequentist) descriptions or predictions of average outcomes, because neither the range nor frequency of possibilities are understood (or perhaps even understandable). In cases in which a phenomenon is non-ergodic or in which true non-caused events are possible, complete knowledge and control are impossible, and both random and new events would be an unavoidable feature of the world. History would not repeat itself in such cases, and surprises a fact of nature.

In addition, in cases where causal chains exist, partial knowledge often produces incorrect theories that incorrectly link actions to outcomes. In such cases, mistakes can also produce surprise outcomes. (Indeed, a good deal of scientific progress is associated with correcting such mistakes.) Mistaken theories may also induce behavior that also generates new risks for the persons taking action. In cases in which causal chains are incomplete or do not exist, better knowledge may also increase subjective uncertainty by revealing formerly unknown risks, such those associated with collisions with asteroids or various genetic propensities.[16]

C. Reducing Losses through Rules and Heuristics

Nonetheless, such risks can often be avoided, if they cannot be controlled. Many of our behavioral rules of thumb: "do's and don'ts" have evidently emerged to do so.

Many of our rule-based methods for reducing risks are learned in childhood. Mobile two year olds are at risk even in the relative safety of their homes, because of their ignorance of the many dangers associated with contemporary lifestyles. Most houses pose risk from falls from staircases and porches, and of electrocution from electrical outlets and a a variety of electric machines. There are sharp knives and scissors in most kitchens. There are poisonous cleaning fluids, medicines, and insecticides in many bathrooms. Immediately outside the home, there are many risks from traffic in the street.

All these pose existential threats to children and adults, but children are at greater risks because they have not internalized the rules which eliminate or greatly reduce the risks associated with their local environments. After such rules are

[16] See Bayarri and Berger (2004) or Samaniego (2010) for discussions of frequentist vs Bayesian approaches to stochastic phenomena. Durlauf (1991) provides a pioneering integration of non-ergodic phenonon into economics. His analysis shows how associated coordination failures can generate significant aggregate volatility. This book, for the most part, adopts a frequentist perspective on risk and uncertainty. The appendices, however, include some quasi-Bayesian models of learning and adaptation.

internalized, a person are no longer tempted to accidental suicide by drinking the odd fluid under the sink, jumping out windows, putting metal knives or pins into electrical outlets, or chasing an errant ball across the street without looking.

When behavioral constraints become internalized, as reflexes, a broad range of household dangers are eliminated without devoting much additional attention to them.

Unfortunately, the risks of modern life are not faced only by ignorant children. As young adults, new risks come to fore, and we are again encouraged to follow a variety of rules that can eliminate or reduce losses associated with our greater mobility and independence. There are, for example, a broad assortment of risks associated with sex, even though we are genetically programed to pursue it at great cost. Survival of the species demands it. To these age natural risks may be added one associated with modern civilization. Driving cars with in sufficient care and accidents with firearms are major "causes" of deaths in young adults. Moreover, these risks may be increased by drinking alcohol or the use of recreational drugs. The new rules of thumb do not always eliminate such risks, but if followed they produce "safe" driving and "safe" sex.

Again, many of these rules of thumb can be followed without much attention once internalized. Moreover, they economize on time and attention, because they do not require all those following the rules to fully understand the relevant causal chains (e.g. the biochemistry and physics).

Prudence may be partly instinctive, but how to be prudent is often not. Teenage and young adult deaths from drunk driving, for example, remain relatively high.[17]

One of the advantages of simple, effective, rules is that they economize on time and attention. They can often be followed by persons who have not taken the time to fully understand the risks faced or how they are generated. Not eating a poisonous plant can save a person's life, even if the person following the rule has no understanding of the evolutionary path that produced the poisonous plant's biochemistry, or how that biochemistry disrupts normal life functions when it interacts with human physiology. "Don't eat that," is often sufficient. Indeed, marketing research suggests that negative information ("don'ts") is more influential and travels farther than positive news (Fitzgerald-Bones 1995).

Taking Precautions

When the possibility of losses cannot be entirely eliminated though research or rules, it is often possible to take steps that reduce the probability and extent of damages, rather than reduce them to zero. The steps that can do so may be called "care" or "precautions." Many losses can be reduced, if not eliminated through rules and purchase of risk-reducing goods and services. Examples include such rules as "watch your step," "buckle up," "no texting while driving," and rules or thumb that encourage the purchase of safety equipment. Other risks can be reduced through the purchase of pasteurized milk, vitamins, proper shoes, and

[17] These manufactured risks may lead some readers to believe that we are living in more risky times than in the past, but disease and accidents were much greater in earlier times. In the United States in 1900, more than 20% of children died before reaching age 20, whereas in 2000 less than 2% did so. (See table 106 of 2012 statistical abstract.) This suggests that twentieth century rules, heuristics, and other safety precautions worked far better than those of earlier times.

good tires. Health risks at work can similarly be reduced through the purchase of safety glasses, hard hats, and good office chairs.

Because many rules are conditioned on specific circumstances, effectively applying a rule often requires recognizing the triggering circumstances. Annual "check ups" by auto mechanics and doctors aid detection and response to safety and health risks that we may not easily detect ourselves. Generalized rules of thumb often suggest that people simply "exercise care" or take precautions when making decisions. "Look before you leap" and "watch your back" suggest that focusing attention on risk detection and potential responses before one acts can reduce a broad number of losses.

Becoming Older and Wiser: Informed Prudence and Age

Because there are so many risks that can be reduced through rules and heuristics, we all spend a significant part of our lives learning about new risks and routines for managing them. A good bit of family based training involves techniques for risk management, including in many cases religious training. Many conversations among friends recount risky events successfully dealt with. The news media provides wealth of information about health, financial, and political risks, while commentators suggest rules (policies) for reducing them.

Formal education also includes a broad rules for understanding and reducing risks, albeit often indirectly transmitted. Arithmetic, algebra, and calculus can be used better understand probabilities, average outcomes, and outliers, which allows one to make better decisions in risky settings. History and political science allow us to know more about the range of possible calamities (war, recession, enslavement, dictatorship) that may be confronted, including many that are beyond our direct experience. Economic classes show why risks are associated with price controls, inflation, and depression and how "bad" (risk increasing) public policies may induce them.

As a consequence of ongoing training and personal experience, people generally become better at risk management as they grow older. For example, in 2000, there were 435,166 nonfatal injuries among young bicyclists between the ages of 5 and 22, an accident rate of 597.92 per hundred thousand; while there were only 187,400 non fatal injuries reported by cyclists older than 22, an accident rate of 99 per hundred thousand. In 2000, there were also 162,016 non fatal injuries from poisons among persons 22 and younger (175.87 per hundred thousand), and 172,144 accidental nonfatal poisonings among those older than 22 (a rate of 90.94 per hundred thousand in this age group). The same year there were 42,719 nonfatal injuries reported for motorcyclists between the age of 16 and 22 (153.39 injuries per 100,000 persons in this age group). More injuries occurred in the more numerous population older than 22 (137,052 injuries) but at a much lower rate (70.99 per hundred thousand). In the same year there were 10,973 accidental gun injuries among persons less than 22 years of age (11.91 injuries per hundred thousand) and 12,264 accidental gun injuries among all those older than 22 (6.48 injuries per hundred thousand).[18]

[18] Center for Disease Control (CDC) website, accessed 7-22-12, http://webappa.cdc.gov/cgi-bin/broker.exe.

In each of these cases, the injury rate per hundred thousand for "mature" persons less than half that of less "mature" persons.[19] As we gain direct and indirect experience and internalize a broader range of behavioral rules and routines, our risks diminish although they are never eliminated.

As with risk-eliminating rules, risk reducing rules are often straightforward once causal chains or probabilistic processes are at least partly understood, and so tend to economize on the use of time and attention.

D. After the Fall: Limiting Risks through Risk Pooling

Nonetheless, inspire of all of our rules, heuristics, and precautions, accidents still happen and unpleasant surprises occur. Some events are unavoidable, given our available attention and knowledge. The processes involved may be too difficult to control, given our knowledge, or momentary lapses of attention may lead to a variety of decision errors. The latter are sufficiently common that the phrase "human error" is widely used as an explanation for accidents. For example, about half of all airline crashes in the U. S. are caused by pilot error.[20]

Risk Pooling

If our best behavioral guides cannot protect us from all loss-generating events, then some losses can only be dealt with after the fact.

In such cases, the losses borne by the person(s) directly affected, can be often be limited through various risk pooling techniques. Risk pooling does not reduce aggregate losses, per se, but reduces their impact on individuals, families, and other small groups.

Table 3.1 illustrates the advantages that a person can realize by joining a group that shares part or all of their gains and losses. In the absence of pooling, the worst outcome is -4 and the best outcome is +3. The worst case outcome is not particularly common, by assumption. Smaller losses (-1) are more common. All three states of the world happen to most people during some points in their life (about 1/20 of the time). In very early times, the bad outcomes might be those associated with hunter-gathers, who might be injured, in later times with farmers, who may suffer from a blight, and in the contemporary period with health or liability problems. For purposes of illustration, each person's experience is independent of the other, and so some members of the community experience beneficial outcome X, while others experience loss Y or Z.

Table 3.1
An Illustration of the Advantage of Risk Pooling

	no pooling	½ pooling	complete pooling
Event X, Px = .5	3	2.375	1.75
Average payoff	1.75	1.75	1.75
Event Y, Py = .45	1	1.375	1.75
Event Z, Pz =.05	-4	-1.125	1.75

[19] These numbers are population wide to capture both the choice of hobbies and risks associated with them. In some cases, the types of hobbies chosen, as with bicycling, tends to fall with age, but that older persons both exercise greater care and choose less risky hobbies is part of the point being made here.

[20] A convenient tabulation of fatal accidents associated with flying can be found at: http://www.planecrashinfo.com/cause.htm.

Under partial and complete risk pooling, those with losses benefit and those with above average returns lose. However, that the variance and worse case outcome are reduced for each person in the pool. These are implications of statistical theories worked out in the 18th century with the work of Pascal and Fermat on probability theory.[21] If the outcomes of a random process are independent of each other and if that process has a stable average (mean), then the larger the sample the closer the average of the sample tends to be to that mean, and moreover the smaller is the variance of the sample mean itself.

As noted by Frank Knight (1921) many years ago, the principle of risk-pooling applies best to settings in which the frequency distribution of losses is well understood and the people of interest are risk averse. Risk pooling achieves its benefits through two statistical principles: that of averages and large numbers, and an associated assumption about human preferences. Risk aversion implies that persons would rather bear the average loss, rather than risk the worst possible losses associated with the phenomena of interest. Better to pay for fire insurance, than bear the risk that your house will burn down and have to bear the entire loss.

Statistical theory implies that the larger the number of persons pooling risk the smaller is the variation in the average amount paid out and the lower insurance premiums can be. Thus, although there are diminishing returns from this process, an extended family can average risks more effectively than a family, and a village more than an extended family, and so forth. This principle allows insurance companies to sell insurance for a fixed price, and also plays a role in the emergence of many of the insurance programs of a welfare state, as argued in part II of the book.

Given unavoidable risks, risk averse persons will join "insurance clubs" of various kinds, whether these are formally organized or not. As the saying goes, "there is safety in numbers."

It bears noting, however, that one does not always have to join a group to obtain the benefits of averaging. If each persons experiences the entire range of outcomes on a more or less regular basis, they can self insure. A persons can "self insure" by placing saving some food or money during good periods and drawing down it during bad ones. If the frequency is large enough, such a person could guarantee him or herself the average payoff in each period without joining a group or purchasing insurance. However, in cases in which saving is not possible or the frequency too low to generate a stable average, joining a risk pooling group is a very common method for reducing the volatility of payoffs and/or limiting one's losses.

E. Risk Reduction via Markets

Another ancient technique for risk pooling is simply the participation in trans-regional markets. Broad shocks may exceed the ability of regionally-based groups to average losses among their members, because everyone in the region of interest is simultaneously affected. For example, a region's output of agricultural products may be greatly be reduced by drought, floods, disease, or war. Risk pooling in such instances requires groups that extend beyond the regions affected.

[21] See Bernstein (1998) for a very interesting history of statistical ideas and applications. Pascal and Fermat's contributions are discussed in chapter 4.

If we rule out conquest of and charity from unaffected regions as solutions, there are only two possible solutions: migration to the unaffected regions or the use of commercial networks. Both have been widely used, but as land has become increasingly scarce, transport costs lower, and global markets better developed, the use of markets has gradually become the more common of the two.[22]

Trading networks allow both large and small risks to be averaged across regions lacking familial or trans-regional risk-pooling groups. In the case of agricultural products, the broader the market, the less likely it is that unfortunate weather will affect all farmers. In the case of more local misfortunes, the trading of favors might be sufficient to moderate risks, when supported by norms of "repayment." Such informal risk pooling is consistent with early norms regarding obligations to give, obligations to receive, and obligations to repay (Firth 2004, p. 8). Storing tradable goods may be regarded as a form of market-enhanced self insurance at the level of a group or individual, insofar as the stocks kept on hand are not themselves used to buffer natural or social variations in outputs, but can be used to buffer a broad range of such shocks.

Contemporary markets allow such risk-smoothing to be undertaken through international trading networks and through sales of insurance-like products. For example, in 2012 there was a severe drought in the mid west of the United States, but favorable weather in much of the North East during the same period. As a consequence, corn could be purchased from farmers in the North East by person's needing it in the Midwest. The existence of numerous suppliers spread out over a broad group of micro-climates in which weather varies substantially, produces a more stable overall supply of crops than a smaller region can manage. In addition, farmers in the Midwest may have purchased crop insurance, to protect their income against unusually poor weather. Together transactions allow a broad range of risks to be implicitly or explicitly pooled among a very large number of persons, not all of which may be aware that they are doing so.

Risk pooling, perhaps surprisingly, is likely to have been an important driver behind the development of trans-regional trading networks for both luxury and agricultural goods. Markets in wine and olive oil, for example, have existed for thousands of years around in the regions that surround the Meditaranian Sea. Any major shortfall in local output will naturally induce those who normally rely on local sources to look farther afield for supplies.

Similar diversity in more or less random outcomes also allows organizations (clubs, cooperatives, and firms) to devise various forms of conditional contracts that have the effect of risk shifting and risk pooling. The conventional market for insurance is one instance of this, but so are commodity future markets and credit default swap markets. Organized risk-pooling services are sufficiently valuable that

[22] The world's recorded history includes many instances of mass migration. Migratory hunter-gathers average out food supplies within the regions of their migration. The timing of departures from region to another can be adjusted to variations in weather and local harvest possibilities. Mass migrations from areas affected by famine or war are also relatively common in history and continue into the present. In today's world the result is often "refugee camps" that are supported by resource pools created for that purpose and topped up by voluntary donations by nation states, firms, non-profit organizations, and individuals. In other cases, one groups migration may be another's negative shock, as the invaders attempt to take the fruits of the current residents' fields and stocks. The latter is, of course, a risk that may attempt to managed through collective action--e. g. regional defense, as discussed in Part II.

people will pay for them, and thus the "routine" nature of unpleasant surprises induce a broad variety of such products to be developed and offered for sale.

Risk pooling via markets requires stocks of tradable goods that can be drawn down during hard times. During hard times, such stocks can be used to purchase goods and services in regional markets. Reserves of, attractive beads, gold, and silver--or other moneys, have long been used for such purposes. Stocks of beads may have been used for such purposes as early as 80,000 BCE.[23]

Potential gains to trade clearly vary with the distribution of weather and other shocks being experienced across regions connected through trading networks.

Of course, not all market transactions involve risk management, but, markets will tend to emerge that provide many risk reducing goods and services, both of the risk pooling variety and of other goods and services that can moderate risks: from the production of hard hats to credit default swaps. In addition to risk pooling services, a variety of risk detection and management services have also long been traded, as with the services of priests, oracles, doctors, engineers, climate scientists, and economists.

F. Risks Created by Pooling Risks: Moral Hazard

The demand for insurance is often modeled as one in which persons face an exogenous outcome generating process with known properties (e.g. mean and variance) but the principle applies to other settings as well, within limits. This was the setting implicitly modeled in table 3.1.

Many risky settings involve processes that are only partly stochastic, or whose statistical properties are affected by the choices of those bearing the risks. For example, although luck plays a role in a hunter-gather's take on a given day, it seems clear that skill and effort also matter. The same is true of returns from farming, job search, and investment. A good deal of the outcome is stochastic, but the results are affected by choices made by those bearing the risks: farmers, job seekers, and investors. Their choices affect the probability of the loss and/or the magnitude of the loss. Risk pooling can undermine the incentives for persons to make such efforts or take such precautions.

Table 3.2 provides a numerical illustration of the selection of care by two persons (or two groups) who are members of the same insurance club or who purchase insurance from the same firm. To illustrate the problem, assume that the club or firm cannot distinguish between Al and Bob in its pricing, either by law or because it cannot observe care level H. The insurance charges each the same price

[23] Shell-beads have been found at the Grotte Des Pigions in Taforat Morocco, some 25 miles from their place of origin. The age of the stash has been estimated to be 82,000 years old. Some anthropologists speculate that the beads may have been used for exchange (evidently as a tradable reserve or as money). The domain of trade (or at least transport of such portable goods) grew to some 300 miles over the course of the next 40,000 years. A brief account of the history of shell beads is available at http://humanorigins.si.edu/evidence/behavior/ancient-shell-beads. The possibility of and need for larger scale trading networks increased with the advent of stationary agriculture around 10,000 BCE. See Price and Bar-Yosef (2011) for an overview of recent research on the origins of agriculture, which Bar Yosef (Ch. 2) regards to be a method of addressing significant climate shocks. If so, the advent of civilization may be regarded as an accidental biproduct of crisis management.

for insurance and covers losses from event space of table 3.1. Complete coverage assures that the payoff realized is always the highest possible, 3. Insurance is priced to cover the average cost of payouts, which varies with the care exercised by those being insured. (Note that this method of insurance can go beyond risk pooling, per se, in that it can assure more than the average result, albeit at a price.)

Each person's care, H, is assumed to reduce their own losses by amount H, whether insured or not, but at a cost $C = 0.25\ H^2$. Insurance payouts are calculated relative to the highest payoff; thus, additional care reduces insurance costs. In a two person or two group setting, this effect can induce additional care, when properly priced. However, when care is not perfectly rewarded with lower prices, because insurers cannot easily identify the care level of individuals, risk pooling discourages care at the margin.[24]

This effect is illustrated with the game matrix of Table 3.2. Given the assumptions and the three care levels listed on the table, the Nash equilibrium occurs in the upper left-hand cell. The level associated with that cell is somewhat less than the optimal. Both players adopt a care level of H=.8, which is below their jointly best care level (which in this case is the care level H*=1).[25]

Table 3.2
An Illustration of the
Moral Hazard Problem
(Expected Net Benefits when Care, H, Is Unobservable)

Al's Care \ Bob's Care	$H^B = 0.8$	$H^B=1.0$	$H^B= 1.2$
$H^A =0.8$	A, B 1.99, 1.99	A, B 2.44, 2.55	A, B 2.49, 2.49
$H^A = 1.0$	1.55, 2.44	2.00, 2.00	2.05, 1.94
$H^A = 1.2$	1.49, 2.49	1.94, 2.05	1.99, 1.99

Cost of insurance reflects the average accident rate given the possible combinations of care. The cost of insurance falls with the cost of care, however, the marginal private cost of care for H>1 is larger than the associate marginal reduction in losses.

The problem is not that Al or Bob (Type 1 players or Type 2 players) are immoral, but simply that given the incentives that they face, they tend to under invest in care. Although the effect of insurance on care is relatively small in the case illustrated, multiplied by thousands or millions of individual choices, the overall losses could, of course, be much larger.

These and other new risks generated by risk pooling may be considered accidents, insofar as they are partly the result of human action, but not products of

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[24] The optimal taking of care can be characterized by minimizing expected net losses: $N^e = PL - C$, with $P = p(h)$, $L = l(h)$, and $C = c(h)$, which implies that h^* satisfies $P_hL + PL_h - C_h = 0$. Care, h, is chosen to set expected reductions in losses equal to the marginal cost of care. If the benefits from taking care are eliminated by insuring all losses, the first two terms disappear, leaving the last, which implies a corner solution at $h^* = 0$, if the marginal cost of care is greater than zero, $C_h > 0$. $L^e = p(0)l(0) - c(0)$ which tends to be larger than $L^{e*} = p(h^*)l(h^*) - c(h^*)$. It cannot be lower. However, if full insurance is properly priced, $P_h < 0$, which encourages care.

[25] In the case illustrated in table 3.2, the net benefits of care in the absense of insurance are $N^e = (0.5)\ (3 - .25H^2) + (0.45)\ (1 + H - .25H^2) + (0.05)(-4 + H - .25H^2)$. Differentiating with respect to H, setting the result equal to zero, and gathering terms, yields $H^* = 1$.

intent. However, this is just one of many cases in which efforts to manage one risks produces others.

Risk pooling itself can create new risks. If a group completely insures a risk of this type, then average group output will fall as persons shirk a bit at the margin in their other efforts to moderate risks. It bears noting, however, that the direct effect of the care is on one's own net benefits in this case, and only indirectly affects others through changes in insurance rates. This is not the problem addressed by Tort law, where one person's carelessness creates risks for others in the community.

The logic of the term moral dilemma is that in the absence of proper economic incentives, we must trust morals to fill the gap. In principle, moral or other codes of conduct could alter incentives at the margin so that those pooling risks would take optimal levels of care. This probably accounts for the origin of the unfortunate name for what is actually informational or pricing dilemma (Pauly 1968).

What the moral hazard problem illustrates is that there are limits on the ability of insurance clubs, cooperatives, or firms to provide insurance for all potentially insurable events (those which occur with known probabilities). In such cases, some method of screening or moral training for group members might be very useful, which may be why church groups and extended families were the most common insurance groups in the pre-modern period. Alternatively, the sharing rules may depart from simply averaging the collective product.

And, when voluntary organizations fail, or achieve worse results than appear to be feasible, governments may also be asked to provide such services, as developed in Part II..

G. Survivorship and the Evolution of Risk Management

To this point we have reviewed a variety of steps that can be taken by individuals and small groups to reduce a wide variety of risks. Most have long been in practice, because the principles of research, rules, and risk pooling have not themselves changed very much through time.

Nonetheless, it clear that the practices of risk management have evolved through time. Rules become more sophisticated, as risks and conditioning variables become better understood, as with weather, disease transmission, and fire control. Risk pooling, similarly, becomes better as the domain of possible outcomes are better understood, and problems associated with risk pooling (moral hazard and adverse selection) emerge and are resolved. Some rules of thumb work better than others in the sense that they more effectively reduce the frequency of or extent of losses for some narrow problem at hand, or are more general and robust and so can be used to deal with a broader range of unpleasant surprises. Some methods of risk pooling require fewer resources to implement than others, or have smaller moral hazard problems associated with them.

Because many of the methods of risk management are not immediately obvious, most of our methods have been "inherited" from previous generations rather than created by the individuals using them. Most of the norms and rules of thumb that we confront as youngsters are passed on to us by parents, who

encourage them until they become reflexes or rational, if customary, methods of avoiding risks. Still others are learned from friends, neighbor, and teachers. Still others are matters of formal law, codified, and enforced by courts and rule making authorities, as will be discussed in Part II.

Although humans are evidently not very good at dealing with risk, survivorship and social evolution helps speed this process of learning along. A family, village, or other organization that promoted a care level below H=1 (from table 3..2) would, on average, do more poorly than those promoting a care level of H=1. If the payoffs are interpreted as personal wealth or health, then wealth and/or population would decline every year both absolutely and relative to groups promoting the better norm. Families and organizations with better risk managing rules are more likely to have successors and others copying their rules.[26]

Individuals and small organizations that lack proper rules and routines for managing risks are less likely to survive and reach maturity than those who have better rules. Moreover, the importance of risk management and the long term existence of particular risks produces biological advantages for particular genotypes. For example, repetitive episodes of diseases will favor persons with bodies that respond appropriately to attacks. Thus, immune systems tend to evolve through time in a manner that reduces the risk from a broad range of recurrent diseases.

These evolutionary advantages are reinforced by competition among families and organization for control over resources. In relatively "benevolent" environments, a variety of standing policies can produce viable communities, because a wide range of actions produce sufficient surpluses for survival. In such circumstances, other goals that modestly (or substantially) reduce survival prospects may be adopted without significant effects on a community's prospects for survival. In more challenging environments or circumstances, the range of policies consistent with survival is narrower, and only societies with relatively effective survival-oriented policies will consistently produce sufficient surplus to survive in the long run.[27]

The more demanding the circumstances, the fewer rules of thumb will past the survivorship bar, because fewer courses of action provide the necessities of life. The more variable the circumstances (e.g. less stationary the relevant frequency distributions) the greater is the need for robust rules, and the more likely it is that only robust rule will be passed on to successive generations.[28]

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[26] There is a broad literature on aboriginal sharing rules which among other things pool risks. Within the economics portion of that literature see Bailey (1992), Steckel and Prince (2001), and Anderson and Hill (xxxx).

[27] A shift from somewhat benevolent to much tougher circumstances evidently affected the Norwegian settlements on Greenland, as the Little Ice Age emerged. Diamond (xxxx) suggests that the climate effects may have been reinforced by economic ones, which reduced the value of settlement exports (especially ivory harvested from walras tusks) and also tended to reduce reserve accumulation and reserves.

[28] This is not to say that individual experience and innovation never occur, but it is to say that, apart from cases in which major improvements in the understanding of a risk generating phenomenon occurs, these will tend to be modifications of existing techniques for risk management, and will tend to be passed on only when they prove at least as useful as the original rules. Major breakthroughs such as the electricity theory of lightning, germ theory of disease, and macro-economics, in

Risk Aversion and Evolution

Given this, it should be clear that human preferences over risk are themselves likely to be at least partly evolutionary in character. Risk averse persons will always (by definition) prefer a steady (certain) average result to the wide ranging ones with the same average.

Maximin decisionmakers are the most obviously risk averse decision makers, insofar as they attempt to maximize their minimum payoff. They would thus always prefer the average of a distribution of losses to the entire distribution. As a consequence, such persons always prefer pooled to unpooled risks, since pooling increases worst case outcome. Risk aversion of the sort used in most economic models is less intuitively obvious than for minimax persons, but they also prefer pooled to unpooled risks, although for similar but more subtle mathematical reasons. In their case, the utility lost from hard times is larger than the gains associated with equally good times, making the average an attractive option.[29]

Either sort of risk aversion has survival advantages at the level of individuals. Evolution favors risk averse behavior in settings in which death is a possibility. For example, if the -4 result of table 3.1 causes death from starvation, persons that join a risk pooling club (tribe or insurance cooperative), are more likely to survive than those that do not. This does not necessarily imply that full risk pooling enhances survivorship more than partial pooling, as noted in the subsection on moral hazard, but effective risk pooling always enhance survival prospects.

Because of survivorship advantages, both risk averse preferences and risk pooling may occur whether the statistical rationales are understood or not.[30]

H. Conclusions: Risk Management is Central to Life

Many of our standing routines for risk management are so mundane, that we give them almost no thought. We are rarely tempted to jump off cliffs, drink the odd liquid under the sink, or purchase land on a river's flood plain We exercise a bit more care in which a fall becomes more likely or more dangerous, as on snowy days, in living rooms after Christmas gifts have been exchanged, or when walking the trails down the Grand Canyon. When a bit more traffic turns than usual up on our usual route to work or shopping, we may shift to our second favorite route, to reduce the chance that we'll be held up in traffic. We also, for the most part, avoid dangerous drugs and investment portfolios.

Through time, the accumulation of knowledge allows more effective behavioral rules, precautions, and risk-pooling methods to be worked out. Thus, the losses associated with well-understood risks tend to diminish through time.

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contrast, may lead to entirely new routines, in part because decision makers become aware of entirely new strategies for addressing risks: lightning rods, disinfectants, and fiscal policies.

[29] In technical terms, risk averse persons have strictly concave utility functions. Every convex combination of points on the surface of a strictly concave function always lies below the function. Since expected utility values are often convex combinations of such points, expected utility values often generate expected utilities below that which can be reached with the average value (obtained with certainty). That is, for any two outcomes H and L, $u(PH+ (1-P)L) > P(u(H) + (1-P)u(L)$.

[30] Bailey (1992) provides a very nice overview of the optimality of aboriginal property right systems, including sharing rules. He analyzes among other factors the effect of conditional probabilities and knowledge bases on the best system of rules (property rights) for members of a group.

Increases in knowledge often make some events more predictable than before. Techniques for diversification and risk pooling are worked out which reduce the variation in outcomes for those in the pool. Risks from the behavior of one's neighbors are reduced through norms and laws governing relationships between both known and unknown persons. Local droughts does not usually threaten those affected with starvation, because food markets are worldwide, which pools the risks worldwide. Knowledge and trial and error allow various rules and routines to be worked out that reduce recognized risks, as with law enforcement, fire brigades, watch towers.

The Limits of Risk Management

There are exceptions, of course. Our daily and annual struggle to cope with the weather remain, in spite of the fact that essentially every human who have ever lived has direct personal experience with the weather and has interests that could be advanced by better understanding it. Knowing more about weather has helped experts to predict weather a few days further into the future than possible a century ago, but detailed predictions of weather more than a week or two away remains impossible in all but the simplest climates. Controlling the weather also remains impossible.

In many other cases, new risks are introduced at the same time that others are reduced. Technological advance may eliminate risks, at the same time that it introduces others. Many infectious diseases have been brought under control through better hygiene, sanitation, and antibiotics, while new risks from overly hygienic lifestyles and new strains of antibiotic resistant germs are created. A major meteorological event can still generate problems beyond our standing routines, contingent planning, and insurance. A sudden tornado, flood, or storm will leave persons displaced, homeless, and, in economic distress. In especially troublesome cases, thousands may die.

Not every unpleasant contingency is planned for nor can every risk that remains be insured. Many unpleasant surprises produce only minor inconveniences as we adjust our plans to take account of them. Others produce catastrophes of individuals, groups, and governments in spite at our best efforts at risk management. Nonetheless, a residual of unpleasant, unplanned for, uninsured surprises always remains.

Crisis, as opposed to risk, management is explored in the next chapter

Appendix to Chapter 3: Some Supplemental Illustrations and Models

The analysis of chapter 3 is grounded in a few fairly straight forward rational choice models. Rather, than bring the models into the prose above, it was decided to shift them to the appendix. For readers who do not often use models, this makes the prose more linear and the argument easier to follow. For those who use models, it may raise suspicions that the analysis is without consistent or sharp foundations. This appendix shows how minor extensions of conventional models can provide such foundations.

The Allocation of Time and Attention

The core model of neoclassical economics is the utility maximizing model of human choice. In the usual framework, an individual is modeled as a shopper in the world's grocery store. He or she has a more or less fixed budget (usually money, but sometimes time) and divides that money up among goods and services to maximize utility. The prices and satisfaction(s) associated with each product is assumed to be known beforehand. These simplifying assumptions allow relatively simple and powerful models of the connections between prices, wealth, and consumer choices in ordinary markets. It is in effect a model of shoppers who create complete and perfect shopping lists. Such persons are in complete reflective equilibrium, both before entering and after leaving the store.

A similar model can help us understand how a forward looking (rational) person would allocate their time and attention to avoid or reduce risks of various sorts.

Table 3.3 illustrates a forward looking person's allocation of attention among tasks, where attention may involve monitoring and responding to existing circumstances or engaging in planning exercises. In the illustration, the individual--again let us call him or her Al, is dividing his or her attention among 5 activities that are more or less simultaneously engaged in. In some cases, Al's net benefits from an activity are greatly increased by focusing attention on it, as with activities B and D; in others net benefits are less affected by Al's time and attention, as with activities A and C. In still other cases, monitoring and planning yield so little in return that it is not worth Al's time and attention as with activity E.

The final allocation of planning effort reflects the marginal returns from focusing on the activities Al has on his or her plate.. In the end, more time and attention are invested in mundane activity C than important activity B, but none on activity E. Unknown or neglected activities, such as G, are not given any attention, because they are not know to exist.

Table 3.3 Rational Use of Time and Attention
Allocating 30 minutes of planning or monitoring time
(Cells values denote anticipated marginal benefits
for the activity of interest.)

Planning	Activity A	Activity B	Activity C	Activity D	Activity E	Activity F
1 minute	100	200	20	150	10	90
2 minutes	80	160	19	100	9	45
3 minutes	60	120	18	50	8	22
4 minutes	40	80	17	25	7	11

5 minutes	20	40	16	12	6	5
6 minutes	10	15	15	6	5	2
7 minutes	5	7	14	3	4	1
8 minutes	4	3	13	1	3	0
9 minutes	3	1	12	0	2	0
10 minutes	1	0	11	-1	1	0

In an uncertain, complex, world, we have other things to do with our time and attention than working out complex, contingent plans, for all possible events and activities. Some activities benefit little from additional data collection and analysis, whether because much is already known or because of complexities that overwhelm short efforts to understand relevant causal relationships. Some contingencies may be judged to be so unlikely as not worth the time to take into account. This may simply be because one has a fixed supply of attention within a given time period. In such cases, some potential losses will be neglected because it is believed that such losses cannot be avoided or reduced sufficiently to warrant shifting attention to monitoring, response, or planning with respect to the activity of interest from some other activity where it is productively employed.

On the Structure of Risks that Can be Controlled

To say that a risk can be controlled is to say that human actions can affect the probability of loss and/or the extent of those loses. In some cases, the actions are relatively simple. A broad range of risks can be reduced or eliminated by simply avoiding some kinds of choices. Others can be reduced by engaging in particular behaviors. In other cases, the required actions may require major capital

investments, as the risk of floods can be reduced through dikes, dams, and levies, or of fatal car accidents through seat belts and sophisticated engineering of the structure of the cars themselves.

When a relatively narrow range of actions need to be undertaken or avoided, it is often possible to summarize the required behavior with a relatively simple rule or norm of some kind. "Thou shall not" or "thou shall always." Table 3.1 illustrates the kinds of payoffs that lend themselves to simple behavioral rules of thumb. In table 3.4, action A is always a disaster relative to the other alternataives. So a rule that induced persons to avoid "A" would increase a person's average net being, no matter what state of the world obtains (again X or Y). The same matrix of actions, states of the world, and payoffs also suggests that a rule that strongly supported action C, would also advance the interests of anyone facing this stochastic environment.

Table 3.4
An Illustration of the Advantage of Risk Reducing Rules

	Action A	Action B	Action C
Event X, Px = .5	-5	2	4
Average payoff	-4.5	2.5	3.5
Event Y, Py = .5	-4	3	3

Within the environment in question, it is more important to avoid strategy A than it is to choose C over B, and so it may be more likely that a norm opposing "A" emerges than one supporting "C," but either sort of rule would tend to be

helpful for individuals, whether they knew the environment (probabilities and conditional outcomes) or not.

Rules of thumb differ from the above rules in that they do not always yield the best outcome. There may be some circumstances, often relatively rare ones in which the rule breaks fails to deliver lower risks or higher returns. And these outcomes may be ignored by those constructing the rules out of ignorance, or simply because they are so unlikely that they should be taken seriously, as with winning the lottery.

Table 3.5 illustrates such a case. It departs from the previous example, buy adding a third state of the world, Z, that is an exception to the anti-A and pro-C rules above. Z is a state of the world in which strategy A works best, but it occurs rarely. An exception undermines the strength of the anti-A and pro-C rules as guides for decisionmaking, but it does not eliminate their usefulness. In 95% of the circumstances confronted, those simple rules still allow individuals to avoid serious losses and/or maximize average returns.

Table 3.5
An Illustration of the Advantages of Risk Reducing Rules of Thumb

	Action A	Action B	Action C
Event X, Px = .5	-5	2	4
Average payoff	-4.4	2.4	3.3
Event Y, Py = .45	-4	3	3
Event Z, Pz =.05	2	1	-1

Such contemporary rules as don't drop out of high school (A) and do graduate from college (C), are contemporary examples of such rules of thumb for young adults in the West. They work most of the time, but occasionally a farmer will do better than a college graduate, as during a great depression. There are many other normative rules of thumb, which work in most but not all circumstances, and they are obviously not limited to the Western normative theories.

Such rules tend to be useful guides as long as the relative frequency of outcomes and the payoffs are stable. This is not always the case, and so many such rules are adjusted through time as circumstances change, although doing so without relatively complete information tends to be a bit risk in itself. Adhering to a rule after its usefulness is over can lead to disaster, and thus the meta-norm in support of rule-following behavior also is to be a rule of thumb. Occasionally, new rules and breaking rules will be necessary, partly because not all rules are well grounded in the first place, and partly because circumstances change.

More complex rules are for the most part similar to those above, but have broader states of the world upon which they are conditioned. That is to say, they are rules or rules of thumb that apply to specific circumstances. But again the point of the rules is that some actions are broadly less risky and/or rewarding than others. However, adopting new rules and routines when circumstances have not really changed can also lead to errors and crises.

Chapter 4: Crisis Management: Coping with the Unexpected

> The practical limitation of knowledge, however, rests upon very different grounds. The universe may be ultimately knowable, ... but it is certainly knowable to a degree so far beyond our actual powers of dealing with it ... It probably occasions surprise to most persons the first time they consider seriously what a small portion of our conduct makes any pretense to a foundation in accurate and exhaustive knowledge of the things we are dealing with. ... The facts [also] suggest a connection with that other age-old bone of contention, the freedom of the will. If there is real indeterminateness, and if the ultimate seat of it is in the activities of the human (or perhaps organic) machine, there is in a sense an opening of the door to a conception of freedom in conduct. Knight, F. H. (1921). *Risk, Uncertainty, and Profit* (Ch. 7).

> Given the large number of components that combine in non-additive fashion, ... our knowledge of how to design these (institutional) systems will continue to grow, but will never be complete. A soon as one design has proved itself in one environment, innovations in strategies adopted by participants or changes in the environment in which a humanly designed system is in operation will produce unexpected results. (Ostrom 2005: 255).

Frank Knight (1921, ch. 8) introduced the distinction between measurable and unmeasurable uncertainty. Some phenomena are sufficiently commonplace and regular that a probability or conditional probability can be assigned to them based on past observations. For others, uncertainty is so great as to preclude measurement and the assignment of such probabilities. He used "the term 'risk' to designate the former and the term 'uncertainty' for the latter."

His vocabulary is less important than the conceptual distinction for the purposes of this book. Knight's main interest was how uncertain gains affected economic activity, which he suggests affects the organization of all industries, not simply the financial and insurance industries. This book, in contrast, focuses on how uncertain losses affect governments, laws, and regulations.

The chapter, nonetheless, like the past two, overlaps with Knight's efforts insofar as it investigates steps that individuals and small groups can take to deal with unmeasurable uncertainty. Such steps will be referred to as crisis management, whenever losses are involved and plans may have to be changed quickly to mitigate those losses. If large and small crises are everyday events, then methods for dealing with them--to the extent this is possible--will be worked out.

A. A World With Only Insurable Risks

As a point of departure, it is useful to imagine a world in which there are no surprises. In such settings, one knows everything that can possibly happen, why it can happen, and the probability that it will happen. This would be true of one's relationship to nature and with respect to other persons. Such complete knowledge allows the possibility that a forward looking person could adopt a long term plan on day one of adulthood, and simply follow that plan for the rest of his or her life. This is the usual assumption of most rational choice models.

In economic markets, competition among such persons would assure that prices would reach their full equilibrium levels, as in Walras' village market, and adjust perfectly for such day-to-day probabilistic phenomena, whether insured or not. Insurance would be widely used to offset essentially all risky (measurably

uncertain) events. This would be done by very large firms that prosper because of the properties of sample means. Differences in income would be entirely determined by inherited wealth, talent, risk preferences, with perhaps a sprinkling of luck--insofar as someone must win the occasional lottery, although lotteries per se would be simply relatively unprofitable forms of entertainment.

All employees would be paid according to their contribution to the world economy's total output (their risk adjusted marginal value product). All market prices (in competitive sectors) would reflect the material costs of the last units produced, and technological developments would affect those prices in a predictable manner--since technological developments would also be, essentially, known beforehand. Stock and bond markets would move ahead in lock step, with rates of return among both varying only because of unavoidable, but known, risks such as those associated with such phenomena as sun spots, global warming, and the various mixed strategies adopted by rivals in less competitive markets.

The economy in such cases might be said to resemble a clock in the short urn, as firm, employee, and consumer choices mesh in a precise gear like manner. In the long run, it could be said to resemble an hour glass as capital and knowledge were predictably, if a bit randomly, accumulated through time and the economy (total income) grew steadily. There would be no totally unexpected products, no totally unexpected events, no missing facts or lacuna of ignorance. As a consequence, the economy's trajectory through time would be well known, at least probabilistically.

This is, of course, the core model used in most of contemporary economics, and it is a surprisingly useful first approximation for a good deal of economic activity in the short run.

B. Unpleasant Surprises and Uninsurable Risks

However, surprises do happen. Great innovations change the course of economic life, as with agriculture, trade, the steam engine, central heating, indoor plumbing, the horse-less carriage, and lately the Google search engine. Lessor innovations may also surprise us and have similar, if smaller effects, on our own lives and on the world's economy, as might be said of movie theaters, watches, the color "off white," and smart phones. Rivals may surprise others with completely new strategies or business plans, rather than simply mix those already known.

The possibility of surprise has profound effects upon the nature of life in small groups and in market transactions. Surprises mean that participants in such private transactions cannot simply adopt perfect, complete, long-run, strategies on our first day of adulthood, and expect that life's plan to work as well as hoped. It will have to be refined to take advantage of pleasant surprises and to cope with unpleasant ones to do as well as possible--or in some cases, to do even tolerably well.

On the Origins of Surprise

The possibility of surprise, although obvious to most of us, needs to be explained. A central tenant of the methodology of many scientist is that everything is caused, that everything that has happened, had to happen--at least after the Big

Bang. From that methodological perspective, the dynamics of the universe consists entirely one-to-one mappings from what came before into what is occurring now and what will occur in the future. Everything that exists today (and tomorrow) had to be exactly as it is. Everything is potentially predictable.

This Deistic perspective allows for surprise, but only because of ignorance. When a dice is rolled, the number on top--for example, a six--had to be on top, because of the manner in which the dice was thrown, characteristics of the surface on which it landed, air density, gravity, and the rotation of the earth. That specific result is entirely predictable--at least in principle.

For those who accept the strong causality principle, "god does not play with dice," and surprise can only result because we fail to understand the true causal chains in which we and everything else are bound. Indeed our lack of understanding must also be caused in much the same way, as would our gradual reductions in ignorance. There is no room for chance, free will, or creativity from such a methodological perspective, although there is room for surprise.

A somewhat weaker theory of the universe allows for at least probabilistic possibilities. Einstein's quote above was evidently the result of his frustration with quantum mechanics, which seems to imply that the world is fundamentally random rather than mechanically caused. Among physicists there is some disagreement about this, with a non trivial group retaining the believe that quantum effects are mechanical, although the mechanism is not understood, and others who believe that it is random.

If there are truly stochastic phenomena in the universe--that is phenomena that are not mechanically caused--surprises may arise for reasons not associated with ignorance, per se. Some forms of uncertainty may be fundamentally unmeasurable, rather than simply unmeasured. When truly stochastic penenomena are added to complex causal chains, the domain of unmeasurable uncertainty explains enormously.

Through ignorance we may fail to recognize a relatively simple and mechanical causal chain or a simple stochastic process. Disease transmission was a complete mystery before the germ theory was worked out and more or less confirmed. Now, we only wonder why some people get sick and not others when exposed to the same germs. Is the later causal or stochastic, or a combination of both?

Unmeasurable uncertainty may result from a variety of processes. Some causal chains may be so complex as to defy systematic understanding or control. For example, a finite-move game of chess can be shown mathematically to have a Nash equilibrium, but that equilibrium cannot be computed by human players, nor, at least so far, by chess-playing computers. Unlike, the even simpler game of tic-tac-to, not every game played by forward looking players ends in a draw.

Chaos theory suggests that causality can be extraordinary subtle and result affected by a host of tiny, extremely difficult to measure phenomena. As the story goes, a butterfly in Asia may cause a hurricane in Florida, (Waldrop 1992). Other phenomena may be inherently unmeasurable. The Heisenberg uncertainty principle demonstrates one cannot know everything about small particles, because the act of

observation tends to change the path of the particle.[31] The same could be said about many social phenomena Moreover, the process generating some natural or social events may be a statistical phenomena, but one that does not repeat itself in a reasonably short period. Non-ergodic processes lack this property, and so unobserved possibilities continue to emerge, no matter how much experience one has with the process of interest. When these three sorts of problems are combined with the natural limits of human time, attention, and computational constraints, both external events and the consequences of human action are often surprising.

The above suggests that phenomena can be conceptually divided into four categories: (i) causal and well-understood, (ii) stochastically well-behaved and well understood, (iii) poorly understood, but potentially belonging to categories (i) or (ii), and (iv) irreducibly uncertain because of the nature of the phenomena themselves or human capacity for understanding. For the purposes of this book, it is sufficient that at least the first three categories are confronted on the a regular basis. The term "Knightian uncertainty" refers to the last two categories. The more important these two categories are, the greater the role that surprises must play in any coherent theory of private and public choice.

Standing Reserves: Rainy Day Funds

One very effective common strategy for reducing the losses associated with unpleasant surprises is to maintain uncommitted reserves (rainy day funds) that can be either be used to cope with a crisis as it happening or to help limit the losses borne by those harmed after the surprise event runs its course.

The existence of uncommitted resources that can be rapidly shifted to address the problems generated (e.g. stem the losses) is an ancient technique for addressing surprise military attacks and unusual variations in annual crops. Free military reserves can be shifted from a more or less central location to the point of attack. Agricultural stockpiles can be tapped in cases in which annual supplies fall below some threshold. Similar strategies are also undertaken by individuals and small groups as with "rainy day" funds and stocks of tools, food stuffs, and cash reserves of various kinds.

In cases in which the main risks are financial ones, the free reserves may consist of liquid and safe assets such as cash or safe government bonds. In cases in which the risk is one associated with agricultural cycles, food and seed reserves may be kept that are greater than necessary for the "normal" fluctuations of agricultural output. In cases in which military threats are thought to be the problem, mobile reserves may be kept at convenient locations for dealing with surprise attacks that can be rapidly deployed.

[31] Heisenberg (1927) demonstrated that "the more precisely the position of a particle is determined, the less precisely the momentum is known in this instant, and vice versa. One could know one or the other, but not both with complete accuracy. See http://www.thebigview.com/spacetime/uncertainty.html or Wikipedia for intuitive discussions of several uncertainty principles from physics. Heisenberg won the Nobel prize in 1932 largely for his uncertainty principle at the age of 31. After WWII, he was one of the founders of the Max Planck Institute for Physics. See also http://www.nobelprize.org/nobel_prizes/physics/laureates/1932/heisenberg-bio.html.

The existence of free reserves, of course, involves sacrifice in the periods that lack crises, but the fact that resources are held in reserve, rather than employed in some other way, allows a more rapid, and often less costly, response to a crisis. Without such reserves, resources would have to be drawn from other uses, which would produce other losses--indeed may exacerbate the crisis, by producing others. For example, the shift of police from "normal" duties to anti-terrorism controls may cause crime rates to rise.[32]

On the Difference between Rainy Day Funds and Insurance

Emergency reserves or "rainy day" funds resemble conventional insurance, but differ in significant ways. Conventional insurance companies create insurance funds that are shared among subscribers for a price based on average payouts and their variation through time. For surprise events, such calculations are not possible. The sample size may be too small to accurately estimate payout rates, or the range of losses generated may be too large for robust funds to be accumulated. Indeed, in many cases the event space and its associated losses are not fully understood. Some losses simply cannot be insured by profit maximizing organizations.

The difference between ordinary insurance and emergency funds can be illustrated by contrasting the problem of insuring events generated by thos of a uniformly and a normally distributed loss generating process. Within a uniform distribution, complete insurance for any finite number of worse case outcome is possible, because the lowest payoff is bounded. In contrast, a normal distribution includes the possibility of infinite losses and so reserves sufficient to handle all events are impossible. An insurance fund can be designed to cover 99% of loss scenarios, but not all of them.

In cases in which losses can be very large, insurance companies normally insure damages only up to a limit, and often insure only a subset of the events previously experienced. For example, home insurance policies have a maximum payout and routinely exclude losses from floods and revolutions (where multiple, large, simultaneous, claims are likely). Similarly, liability insurance normally is sold with a maximal judgment for a single claim and maximal total for simultaneous claims. Losses from wars, earthquakes, tsunamis, and major business cycles cannot be insured by firms in markets--and when a company promises to "do so," they normally become bankrupt when they are actually asked to pay off the enormous claims associated with such events. Nor, can losses which few if anyone has taken into account. Risk that can be contractually bounded can be mitigated through various insurance instruments, while unbounded losses and complete surprises cannot.[33]

Prudent insurers recognize that they cannot accumulate sufficient funds to cover damages from all possible combinations of emergencies and/or sell such insurance at a reasonable cost. Some uncertainties are unmeasurable, others are so

[32] Research by Benson, Kim, Rasmussen, and Zhehlke (1992) and Klick and Taborrok (2004), for example, suggests this will be the case.

[33] Knight suggests that risk pooling is possible for unmeasurable risk as well as measurable ones, but his reasoning depends on the law of large numbers and averages applying--which is equivalent to saying that the unmeasured risks have the same properties as the measured ones covered in routine life insurance policies.

large and rare that prudent insurance funds cannot be accumulated. In such cases only "self insurance is possible. However, the "insurance" that is self provided is not always true insurance that places a lower bound on downside losses. Rather, losses are reduced or managed through emergency reserves of various sorts. Coverage from private rainy day funds also have their limits, but these are not determined by contract, but by the size of the funds. In well developed markets, lines of credit may also serve as "free reserves." Such rights to borrow--up to a limit--are essentially similar to other asset backed sources of reserves that can be drawn down during emergencies.

In settings with well-developed private insurance markets, many downside losses will be bound by insurance like instruments. The residual of uninsured risks will be moderated with reserve funds of various kinds--albeit imperfectly. Because of this, prudence will also require modifications of standing routines, contingent plans, and institutions.

C. Planning for Crises

That surprises may be jointly generated by various combinations of potentially measurable and non-measureable processes has clear implications for the plans that individuals and small groups adopt to deal with crises.

Perhaps the most obvious change will be to reduce the scope of long term commitments. Flexibility is an important aspect of plansthat are likely to be revised to take account of surprise events. In any domain in which surprises are deemed likely, one should avoid most lifetime contracts. In some fields, the best jobs and best services may change in unexpected ways--and many times--during a lifetime. Similarly, one should not bar and lock the door, if opportunity may knock or an escape from fire may be necessary. As the poet Burns once wrote, "The best-laid schemes o' mice an' men Gang aft agley." In settings where surprises are common place, the best permanent plans may fail nearly as often as a series of myopic responses.

This is not to say that all long term commitments will be avoided, but in areas of life in which surprises are commonplace, commitments that reduce one's ability to respond to surprises will be avoided. in those areas of life. Reducing short term commitments allows one to avoid losses and increase profits that might be obtained by revising one's plans.[34]

For economists who neglect the existence of surprise events, such plans will appear to be suboptimal, although they are not for the actual circumstances confronted. However, given that surprises will occur in the future, robust, flexible plans will dominate ones that appear to be more fruitful in the short and medium term (foreseeable future).

In addition to increased flexibility, the sources of surprise events have implications for the kinds of flexible plans that are likely to bear the most fruit.

[34] It bears noting that common law appears to acknowledge the importance of such surprise events. Contracts can be breached for a variety of reasons including "acts of god" (major surprises) and, subject to damages, simply unexpected profit opportunities.

Atempting to Measure Unmeasured Uncertainty

For example, that surprise may be induced by potentially measurable uncertainty implies that research before the fact may bear fruit. Investigating the causes of surprises that are partly the result of poorly understood causal chains can reduce uncertainty, even if unmeasurable uncertatiny is acknowledged to exist. The result may be better conditional plans before, during and after a crisis takes place.

This might, for example, be said of contemporary efforts to understand earth quakes. Modern tectonics suggests general locations where earthquakes are most common. Once fault lines are determined, places away from fault lines can dispense with the building of reserves and earthquake resistant structures to counter earthquake risks. Measurement of forces along trouble prone fault lines can predict, albeit poorly, the upper bound of the likely magnitude of the next quake. This allows a better estimate of the requirements for emergency reserves and of the extent to which resistance to earthquakes should be incorporated into buildings and other structures. The frequency of earthquakes in Japan, for example, ruled out large stone structures and induced somewhat more flexible designs for wood structures to be adopted before steel reinforcement and other strengthening techniques were developed.

Such research can only eliminate surprise when a perfect causal chain exists, but it can reduce uncertainty and allow crisis management resources to be economized on.

Improving Plans

Similarly, given scarce time and attention, just as one's knowledge of possible events can be more or less complete, so can one's standing plans. As the extent of uncertainty decreases, the advantages of planning tend to increase. Moreover, as understanding of causal factors improves, plans can be devised that incorporate more complete and correct conditional responses to loss generating events. This does not happen automatically, but requires analysis of how responses may moderate the losses associated with those events. In a setting of crisis, where response time is important, having better conditional plans (and reserves) can greatly reduce losses.

Moreover, in cases in which research suggests that the appropriate "emergency responses" are similar for a broad range of crises, the returns to planning also increase.

For example a broad range of storms, earthquakes, and terrorist attacks produce roughly similar medical emergencies and damage to capital goods (housing, factories, transport networks). Because responses to them can be similar, preplanning allows faster responses and reduces mistakes from panic and haste, as long as the rough outlines of the problems are correctly anticipated. Commonalities among emergency responses, allows useful plans to be worked out without complete knowledge of all useful details of the crises that may be experienced.

Nonetheless, because of unmeasurable uncertainty and limits in our ability to collect and analyze data, it must be acknowledged that one can never fully anticipate the exact time and place of an earthquake, contagious disease, terrorist attack, or meteor strike. And, thus, well-planned emergency responses to them will always be imperfect.

Many will have to be revised "on the fly" while the crisis is underway, and in many cases, although improvements over the original plans, the revised responses are not as good as they could be. Relatively high error rates are, of course, entirely predictable, given the need for rapid response.

Those error rates also have implications both for the responses an individual or small group should undertake and what one should do after a crisis is over. That is to say, a standing plan for addressing crises will be flexible enough to allow for necessary revisions to address the crisis, but "exceptions" for the time of crisis will tend to be relatively small. Small revisions, in most cases, will be associated with smaller mistakes and smaller avoidable losses. Formal limits or informal norms that allow marginal rather than major revision allow the emergency at hand to be responded to and without having to reinvent the overall response plan during a time in which data and analysis are likely to be in short supply--and so mistakes unusually likely.

Crisis Detection

Given response plans and emergency amendment procedures, the next critical part of a crisis management plan is determining whether a crisis is under way.

(Again, we focus on unpleasant surprises calling for rapid responses, rather than pleasant ones, crises rather than profit opportunities.)

After the fact, this is usually completely obvious, as with an earthquake, large scale terrorist attack, or financial meltdown. Nonetheless, in the first stages of a crisis it is often difficult to distinguish between a few minor quakes, a odd hijacker, and a market adjustment from the larger events that can generate huge losses. In cases when such events can be detected before they reach their full "natural" magnitude (e.g. that without response), the losses associated with the surprise event can often be reduced.

A useful metaphor for such events is a rising river. Rivers rise after every rainfall, albeit with a lag as new water in the river's catchment basin flows towards the main path to lower ground and eventually to the ocean. If one observes only the water near the dock in one's home town, whether the river will rise a little or a lot cannot be known, until it happens. If however, the extent of the rainfall or snowmelt in the catchment basin is accurately measured, the rise in river level can be perfectly predicted. Moreover, the rainfall, itself, tends to be somewhat predictable for a week or two before it actually rains. Such contributing factors, in principle, allow major river floods to be detected earlier and earlier as more complete data about the extent of rain fall and better estimates of likely rainfall are determined. The earlier a reliable warning is obtained, the more steps that can be taken to reduce losses from a flood, before it happens. People and property may be shifted to higher ground, temporary flood control structures can be erected, emergency supplies pre-positioned. In contrast, detecting a major flood after the river rises to unusual levels, reduces opportunities for limiting losses.

It is, however, not the case that any early warning system is better than no early warning system. Mistaken forecasts may also produce avoidable losses. Evacuating a city unnecessarily for a week will reduce its annual economic output by about 2% and subject all involved in substantial inconvenience and expenses.

Accurate detection of crises, as early as can be done reliably, can greatly reduce losses. But accuracy is important, as is robustness!

Even the more sophisticated early warning system may fail when a surprise triggers the problem: a dam or dike may suddenly break or a hurricane may veer well of the course predicted by meteorological models.

After the Fact: Sunk Costs Are Not Always Sunk

Research after the fact, can thus contribute to reducing long term losses by assessing detection measures and response plans, which allows both to be improved. Such activities would be completely ridiculous (wasteful), if the best possible detection and plans were already in place, as assumed in rational choice models that fail to take account of ignorance or unmeasurable uncertainty.

Such reviews make sense in all cases in which an unpleasant surprise is adapted to. However, ex post review may be even more important for the subset of such cases in which rapid responses were necessary, because such decisions reached during the crisis without much data or analysis will be more error prone than during normal times in which better data and more time for analysis tends to be available. New plans had to be made, or old ones revised, quickly without as much information as can be assembled after the fact.

After the crisis has run its course, the event triggering the crisis can be revisited to improve planning for events similar to the one just experienced. This is not an implication of normal rational choice models because they normally assume that perfect optimization always takes place; however, they also rule out the possibility of surprises--except in macroeconomic models as "external shocks." Since it is obvious before hand that responses to crises will not be perfect, reevaluating the responses made after the fact can improve responses in the future--e.g. reduce losses from future unpleasant surprises--even if future surprises cannot be avoided.

After the fact, one can. analyze what was done and how the results could have been improved by undertaking different responses. The latter cannot be known with certainty until the next crisis, but insofar as experience and analysis bear fruit, this process allows emergency responses to become more effective through time.

Here it bears noting that such "after the fact" analyses are routinely used in all sorts of organizations. For example, sports teams confront "surprise attacks" in nearly every game that they play. Unanticipated strategies are often possible even very rule constrained and ancient contests such as chess, boxing, or football. Opponents attempt to create surprises, because surprises often elicit mistakes on the part of their opponents. To correct such mistakes and better anticipate the "surprise" strategies of their opponents, all professional teams have routine performance reviews following every significant match.

Such *ex post* analysis makes little sense in a world that has only well-known causal chains and conditional probability functions. Nor, do such reviews make

sense if only unmeasurable uncertainty exists. It is because of potentially measurable uncertainty--and of course planning costs--that such review sessions can be very productive. “Monday morning quarterbacking” is not simply a method of entertainment or attributing blame, but rather it is a system to improve future decision making by improving detection and response plans.

A careful review of the decisions made during a crisis, after the fact, tends to be more productive than those undertaken in times of crisis, because more time is available for collecting information and analyzing it. Ex post analysis often allows significant improvements in future responses to more or less similar events. To assure that such reviews are undertaken, the standing policies, routines, and formal institutions of small groups normally include efforts to review and correct errors associated with previous episodes of crisis management after the unpleasant surprise has been weathered.

D. An Illustration of Planning Failure

All this should all seem a bit obvious, since we all deal with crises on an almost routine bases, but it may be less obvious how the possibility of surprise affects formal rational-choice based research. Are sub-optimal plans beyond the scope of rational choice models, as is sometime claimed?

The problems associated with sub-optimal (incomplete) plans can be illustrated in several ways. Table 1 characterizes a relatively simple choice setting that is sufficient to illustrate several of the problems associated with ignorance and sub-optimal partial plans. The person (planner) of interest can take four different actions (X = 1,2,3,4), and may confront three different states of the world ($Z=Z^0$, Z’, Z”).

Table 4.1
Planning without Complete Knowledge of Conditioning Variables

control variable / state	$Z = Z^0$	Z = Z’	Z = Z”
X = 1	2	2	-1
X = 2	3	-1	0
X = 3	1	3	-2
X =4	0	0	2

Suppose that the chooser, Al, has only experienced state Z^0 in his (or her) lifetime. In that case, Al will adopt X=2 as his strategy, because it maximizes payoffs in that state of the world. The payoff may be interpreted as utility, income, or likelihood of survival. As long as $Z = Z^0$, this choice is the best possible, and there are no problems associated with the fact that Al’s strategy for life does not include full consideration of the other Z-states.

However, the state variable may unexpectedly change from Z^0 to Z’. The previous state of ignorance now causes problems. Not only does the standing strategy (X = 2) not work as well in the new state of the world, it produces net losses rather than net benefits that could be avoided with a different strategy--indeed the worst possible outcome.. Fishing from a rock in the center of a river may generate a lot of fish during normal times, but place one at great risk during an unusually high flood.

Al could clearly reduce his losses by changing his strategy--and depending on the magnitude of the losses, Al may need to adjust quickly. In such cases, a change from Z^0 to Z' may be said to have produced a crisis.

In the case illustrated, any change in plans or strategy will be an improvement, because the initial plans were not conceived with Z' in mind, and so they were less robust than they might have been. Indeed as noted, X=2, generates the worst possible outcome in the new circumstances (Z = Z'). Such planning failures are evidently sufficiently common in the real world that decisionmakers during a crisis are often encouraged to "just do something," (e.g make any change in existing plans).

However, not all changes are equally effective at advancing Al's interests. Strategy X=3 is now the best plan. If, however, future switches between state Z^0 an Z' are "anticipated," strategy X=1, has advantages. It performs well in both circumstances--it is a robust plan.

Crises and the Demand for Information

What is known and what is unknown in the new circumstances tends to vary with the magnitude of the change. For example, the relative merits of the four available strategies might not be immediately obvious in the new circumstances. Moreover, it is possible that only a subset of the four feasible strategies were actually known in the original circumstance. The known strategy set may have to be expanded to properly respond to the surprise.

To continue our illustration, suppose that there is a scientific breakthrough that allows data on Z and the relationship between Z and the payoffs from X to be collected for the first time. Three related problems are generated by the discovery that Z is a conditional factor that changes through time.

First, there is the immediate problem. Previous private plans (or public policies) are now revealed to be suboptimal, or at least not to be robust or completely reliable. Second, the shift to better plans may not be possible because the effect of Z on the payoffs of X is only partially understood. Third, the future time path of Z and its effects on payoffs becomes a topic of research. After Z is noticed, the best strategy depends on the ease with which changes in Z can be observed or predicted. If it cannot be predicted, a minimax strategy may be the best that can be adopted. The effects of Z were clearly under investigated and resources (time and attention) may be shifted from other uses to the study of Z's effects. Additional data and analysis will be necessary to understand the future effects of Z on payoffs (income, health, probability of survival, etc.). Z, itself, may be caused by other factors or the stochastic process generating Z may have measurable or unmeasurable characteristics.

If Z simply moves to a new steady state, Z = Z' and the new relationship between X and the payoffs are fully understood at that steady state, complete knowledge of Z may be unnecessary and X = r(Z'), and health reserve E' = e(R', Z') may be adopted. Unfortunately, neither scientists nor policy makers can be sure that Z has simply moved to a new steady state without understanding the

processes generating Z. Has Z temporally increased, moved to a new steady state, or begun a new process of increase? Perhaps Z is a stochastic variable. If so, how is the process generating it distributed? In this manner, a crisis and its associated revelations about one's ignorance may make one aware of previously unnoticed risks and uncertainties, and increase the demand for research on and analysis of associated phenomena.

Developing a better conditional plan based on the discovery of previously unknown causal or conditioning factors is a nontrivial matter. Discovery of previously unknown factors and strategies--breakthroughs--do occur, although not from the Baysesian calculus of mainstream models, for reasons discussed in the appendix.[35] Understanding what has changed and how to cope with it requires creativity--new strategies may have to be devised and previously unknown possibilities may have to be understood. Nor would it be immediately obvious that that a third state of the world, Z," is also possible.

In cases in which the link between the state variable(s) and relative effectiveness of alternative strategies is not obvious, some research about the path of the state variables and the effects of those conditioning factors on the effectiveness of the old strategies can be very helpful--indeed it may be a necessity.

Mistaken Responses

Given the need for quick adjustments and lack of knowledge (or plans) about the new circumstances, mistakes are likely. Indeed, the old strategies may simply be continued, because of an awareness of risks associated with blind adjustments That strategy X=2, has always worked in the past, may be regarded as a sufficient reason to continue using it, until more is known. Getting causality wrong, however, can lead ridiculous strategy choices being adopted.

Here, the reader might recall the wide range of public health problems that plagued mankind for most of human history. Many solutions were tried over many centuries and much analysis was undertaken, but truly successful policies were adopted only in the past century or so as knowledge of bacteria, viruses, and other hazardous materials improved. Few plagues threaten health in developed countries these days, but this is a fairly recent state of development. Contemporary examples of such knowledge conundrums include urgent concerns over the future path of Islamic terrorism, global warming, financial crises, bond markets, and the acculturalization of recent immigrants within OECD countries.

Mistakes and Crisis Cascades

The ignorance and lack of planning associated with all true emergencies implies that mistakes are likely when policies are initially adjusted. Those mistakes may generate new crises insofar as the decisions made have unanticipated effects.

[35] Bayesian updating requires all possibilities to have non-zero probabilities. If unknown probabilities have a "zero prior" than no updating via Bayes Law is possible. Additonal discussion of the limits of Bayesian models of learning are discussed in the appendix.

In the model above, secondary crises might arise in the period in which the relationships between Y and the payoffs of X are not fully understood. For example, hasty scientific research, and policy analysis may mistakenly conclude that strategy 4 is the only safe strategy. But this will requiring subsisting on much less output than Al is used to, and in extreme cases may threaten his survival. Strategy 4 may dominate strategy 2 in the new circumstances, but may be at best a "stop gap," a policy that limits losses but fails to be sustainable.[36]

Haste would not generate future policy problems without knowledge and planning problems, but such problems are essential features of the class of problems termed emergencies or crises. Rapid revision of plans without careful consideration of alternatives or consequences are more likely to produce mistakes than the slower more considered response of ordinary decision environments.

In this manner, ignorance and urgency may generate crisis cascades that are only indirectly caused by the original crisis . In an effort to avoid running over a rolling child's ball or careless cat, a driver may quickly shift traffic lanes and hit a truck.

Some crises get out of hand simply because urgency prevents ignorance from being reduced sufficiently to permit accurate estimates of the (new) consequences of policy revisions.

E. Crisis and Evolution: Rational and Non-Rational Responses to Emergencies

Crises and other unpleasant surprises can be generated by nature and man, as discussed in chapter 2. In a subset of those cases, the losses generated by the new circumstances can threaten survival in the short, medium, or long term. A flood or surprise attack may require individuals, families, and private organizations to respond rapidly if they are to survive high water or a rain of slings and arrows. In the medium term, the recognition of such risks may induce shifts in location or capital stock.

A series of floods that is more damaging than thought possible, may cause potential flood risks to be reassessed and induce a shift in standing long run plans to minimize losses in the long run. Similarly, a shift in climate that makes droughts more common, floods higher, or fires more fierce or frequent may call for an entirely new policy rule. Dams or dikes may be constructed or expanded; living or farming flood zones may be discouraged; fire departments and codes may be created; masonry construction may replace wood; a great fire or defensive wall may be constructed around the community. A family, firm, or village may decide to relocate to a site where droughts, floods, fires, and/or military threats are less severe or frequent.

Many longer term crises can be thought of as instances in which a communities reserves and/or capital are reduced through time, by worse conditions than they had anticipated.

[36] Viscusi (1997) recounts and analyzes many cases in which a bit of new information induced panic and over reaction to crises.

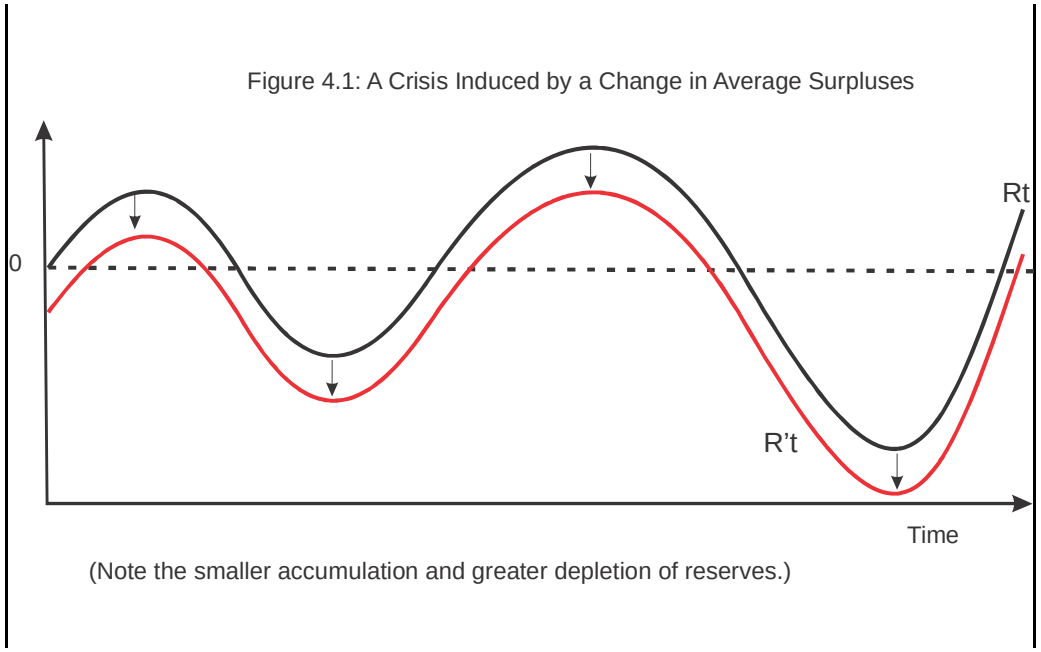

Figure 4.1: A Crisis Induced by a Change in Average Surpluses

(Note the smaller accumulation and greater depletion of reserves.)

When such shifts are unrecognized or not responded to with better plans (plans with greater average surpluses), a family, firm, or community my gradually disappear, as reserves and/or capital diminish beyond that required for survival in a world with random shocks and cycles, such as those induced by weather and the passing of seasons.

Not all such crises are emergencies calling for immediate response, but they are nonetheless settings in which failures to respond properly to an unpleasant surprise poses existential threats. In the long term crises, the need for changing standing policies can be undertaken with more care, but revisions need to be adopted more rapidly than the natural or historical processes the generates the problems. A significant breakthrough in understanding the problem or in possible responses to that problem may be required.

Evolution and Hard-Wired Responses to Crises

Although most economic analysis (and environmental analysis) assumes that new problems are easy to recognize and solve, this is not the case for crises, which by definition emerge suddenly and demand rapid responses. In emergencies, there is not sufficient time to carefully work out solutions (e.g., determine consequences of all alternative actions and rank them in order to create a new or more complete plan or policy response function). This implies that crisis response tends to be more mistake prone than ordinary choices. Thus, intuition and luck, "good guesses," nearly always plays a significant role surviving major short-run crises.[37]

Insofar as luck is historically important, this implies that survivorship pressures, "trial and error" at the community level, is an important determinant of existing routines for surviving emergencies. The responses that worked in the past, for whatever reason, will be passed on to other places and generations. Indeed a subset of such responses may be genetically hard-wired, such as the "freeze, fight or flight" response common among mammals.

[37] These hypotheses can be tested. That errors are more common during crises suggests that the error terms associated with rational choice models will tend to be larger (heteroskadastic) during times of short run crises. If there are also more systematic mistakes (because of ignorance or constitutionalization of policy), dummy variables will also be statistically significant "explanatory" variables for such periods.

Evolution and Rational, Creative, Responses to Crises

That evolutionary pressures partially determine successful routines for responding to crises does not undermine the case for rational analysis of plans and policy alternatives, as is sometimes argued. Even a partial understanding of causality is often better than no understanding, because it makes detecting policy failures easier and faster and provides information about causal and effect that can be used to assess possible responses that have never been tried. Such partial theories tend to increase survival prospects by providing both more complete plans and a better foundation for "good guesses" during a short-run crisis. They may also facilitate the identification of new circumstances in which plans can be improved before a crisis emerges.

That reasoned responses are usually superior to blind hunches does not imply that one should always wait for more or less complete information. The necessary information and analysis generate losses during a crisis, where the speed of policy response during a crisis is often important. The common demand that experts (leaders) "just do something" suggests there are many cases in which nearly any change in plans is better than inaction. Nonetheless, that rationality survives suggests that rational analysis and planning, when feasible, improve average results in both the short and long run.

Moreover, insofar as the planning, detection, refining, review steps in crisis management are natural ones, human mentality may also operate in such stages, repeated endlessly as new surprises (and new information) is acquired. The possibility of creative response and our ability to recognize our own creativity may play a central role in our self consciousness. The thought "I think therefore I am" implies that thinking itself--new thoughts--can be recognized.

Talent at Crisis Management and the Possibility of Experts

Insofar as persons vary in their talents or experience at crisis management, differences in success may emerge in a given generation of persons who are exposed to varying numbers and degrees of crisis. This not only provides an evolutionary advantage for good crisis managers, but also for the use of institutions in which better crisis managers are given greater authority to direct crisis detection and/or responses. Persons who are well informed about robust responses to "most" surprises in given circumstances can often reduce the planning costs of others by teaching them both about the range of possibilities and best responses.

If plans for a given area of action can be grounded on more or less complete and accurate information and analysis, then it follows that "good plans" are likely to perform better than "poor" or "no" plans other things being equal. A planned response can be implemented more quickly and with a greater appreciation of the consequences of an action, than an unplanned response created quickly during a crisis, other things being equal. This is, of course, why plans are made in the first place, although planning requires scarce time and attention.

Because some persons are better at planning than others in a given action area, either because of talent, skill, or better knowledge of possible circumstances, there may be some specialization in planning exercises. A parent may plan for their

children, a retirement planner may plan for the parents, and an expert regulator or professor planning may suggest rules that guide financial planners.

Similarly, organizational governments will include a variety of features that enables them to cope with uncertain environments including the use of various information pooling and mistake reducing methods such as those associated with the king and council form of government (Congleton 2011). Succession plans will exist for systematically replacing senior executives and other personnel critical to the organization's crisis management and innovation programs. Organizations will also set aside reserves and take out lines of credit to help them weather unexpected changes in revenues, costs, rivals, or taxes.

In this manner, institutional designs, and specialization in risk and crisis management tend to emerge side by side with the risk bearing services analyzed by Knight in his chapters on market responses to uncertainty.

Entirely new professions, firms, and industries tend to be associated with efforts to moderate and pool the losses associated with unpleasant surprise. And the organizations themselves will tend to reflect the requirements of crisis management with standing routines for planning, crisis detection, response, and review.

F. Conclusions: Crisis Management as a Normal Activity

The simplicity of some stochastic processes can induce a state of mind in which we can imagine all things being understandable in statistical terms. However as the phenomena of interest become more complex, even if fundamentally similar, the difficult of teasing out the necessary relationships become far more difficult, as has for example proven the case in empirical economics, where nearly opposite hypotheses often have considerable empirical support.

The results of rolling dice and playing chess are largely independent of their circumstances. The distribution and relative frequency of a series roll is independent of past rolls, the surface upon it is rolled, the temperature, race or ideology of the roller, etc. A game of chess is fundamentally unchanged if it is played by Australian Bushmen, Roman Emperors, kings, or grammar school students. So relatively few conditioning variables need to understood to understand the distribution of outcomes generated.

That is not the case for all natural phenomena and rarely the case for social phenomena. At the very least, a wide range of conditional probabilities have to be understood to characterize the stochastic (or complex) processes that generate the outcomes of interest (daily temperatures or demand for life insurance). The extent to which risks can be reduced through better knowledge, risk pooling, and risk shifting devices depends on whether the process of interest is ergodic or not, that is to say whether a process generates repetitive outcomes, or not. If some of the processes is entirely non-ergodic, then new events will constantly be generated, and people would constantly be face unanticipated and unplanned for events.

In choice settings where uncertainty is potentially measurable, ignorance and planning limits imply that we all will at least occasionally confront unpleasant surprises for which no predetermined responses exist. At such points, our plans

may need to be revised--and revised rather quickly to avoid loses that we did not previously take full account of.[38]

That surprises occur is itself completely expected and commonplace, although the particular surprises experienced are not. This allows a variety of steps to be made that can blunt the effects of unpleasant surprises and allow pleasant ones to be better taken advantage of. This chapter in combination with chapter 2 and 3 suggest that a broad range of risk and uncertainties confront decision makers. In many cases, losses can be reduced through various combinations, of standing rules, precautions, risk pooling and the creation of uncommitted or free reserves.

That standing conditional plans are adopted is consistent with the equilibrium models used in most rational-choice approaches to economics, politics, and sociology. That such plans fail from time to time as "unusually unpleasant" surprises occur is not usually acknowledged or analyzed in such models. Instead of analyzing rational responses to "exogenous shocks," such surprises are simply assumed to provide the impulse that moves decisionmakers from one equilibrium to another.

This book suggests that a significant part of a decision-maker's standing routines consists of efforts to reduce the frequency of, anticipate, and limit the losses associated with future unpleasant surprises. To ignore such efforts, is to ignore a large and significant part of life, and a large and significant part of what markets and government also cope with. Taking greater account of uncertainties does not simply add a blank unknown area of choice to one analysis, rather it forces one to think about the wide range of steps that will be taken in such cases.

Household Expenditures and Uncertainty Reduction

If both risks and crises are central elements of life, we should and do observe a wide variety of efforts to manage risk and crisis, not simply unsystematic deviations from the predictions of simple expected utility maximizing models. We should, for example, see greater resources invested in risk reducing strategies, insurance policies that limit what is covered, and standing free reserves. We should see organizations that include persons or units charged with planning for, detecting, and responding to unpleasant surprises. Plans will include fewer and weaker long term commitments than economic models predict. They will be regularly revised, rather than simply implemented. The optimal plan is less detailed and more "flexible," than the best plans for a world without surprise.

Evidence that risk and crisis management are significant factors in contemporary life can be found in break downs of GNP statistics. Individuals spend much of their income on "necessities" (goods and services that reduce health and other risks) and insurance. For example, in the US in 2000, personal consumption expenditures were 6.8 trillion dollars. Of that, health care accounted

[38] It bears keeping in mind that most empirical estimates of micro-economic models have R-squares of half or less. This implies both that the choice settings confronted by individuals and organizations are only partly predictable. This unpredictability may be a consequence of the broad range of unanticipated surprises that consumers confront, both good and bad. These cause plans to be adjusted through time in response to them. Moreover, the errors in static models can be generated from such behavior even if the adjustments are perfect, but also if some adjustments are mistakes that are later corrected, as suggested above.

for 1.1 trillion and insurance a mere 0.065 trillion dollars, about 1/6 of total consumption. Other necessities, for example, housing, food, and clothing accounted for 1.2 trillion, 0.54 trillion, and 0.25 trillion dollars respectively, another sixth of consumption expenditures.

If half of these expenditures can be considered as risk-reducing necessities, then more than a fourth of household expenditures are devoted to risk reducing consumption, health care, and insurance. (See table 677 of the 2012 *Statistical Abstract* of the United States.) Other household expenditures also includes both risk management and recreational aspects, as with expenditures on food services and accommodations, 0.41 trillion, education, 0.134 trillion, communication services, 0.08 trillion, and reading material, 0.05 trillion.[39]

Appendix to Chapter 4: Supplemental Ideas and Models

Differences Between Bayesian Learning and Reduction of Ignorance

The most widely used method of incorporating imperfect information into rational choice models assumes that the basic information problem has to do with poor estimates of frequency distributions. The poor estimates in question are normally assumed to be produced by small samples rather than failures to recognize or know conditioning variables. This allows the poor estimates to be corrected by simply increasing sample size. The most famous applications of this approach are the various search models of market prices (Stigler xxxx) and unemployment (xxxx xxxx) and the various game theoretic implementations of Bayseian subgame perfect equlibria (xxxx, xxxx).

The ignorance representation is less widely used, in part because it is less consistent with some modern characterizations of "rationality" and in part because it appears to be a less systematic and mathematically elegant way of representing the nature of imperfect information. However, both these objections essentially require the absence of surprise, or at least that surprises are relatively unimportant factors in life or in contests, assumptions that we have challenged in chapter 2.

For the purpose of crisis management, the search or Baysian approach have two problems. The search and Bayesian representations of imperfect information,

[39] Of course as often pointed out, a life focused entirely on crisis management may itself undermine one's ability to cope with risks. Time off from lifes many crisis managing chores can refresh the mind and allow better future responses to both pleasant and unpleasant surprises. Recreation accounts for 0.64 trillion, about ten percent of household consumption.

but not complete surprises. Complete surprise is impossible, because there are no "unknown" possibilities. Moreover, the usual Bayesian characterizations of information allows the possibility of mistakes, but not systematic error in the long run. In the long run, everything becomes known as samples (experience) increase to infinity. The later ignores the finiteness of life and the fact that it is impossible to perfectly transfer knowledge across generations. The former is a convenient modeling assumption, but may lead one astray when investigating settings in which surprises and emergencies are possible.

That is to say, in a setting in which natural ignorance exists, two sorts of learning are possible. First, one may gain precision in one's assessments of settings one is already familiar with--e.g. more precise estimates of Xt in the illustration. Second, one may learn about new previously unknown possibilities. For example, variable D might not initially have been known and could be discovered in the course of experience or analysis. Similarly, Alle might not have known that decision node 3 exists or that choice R could ever therefore be sensible. Moreover, choice R itself may not have been known. The first sort of learning can be modeled using the conventional statistical (Bayesian) models of learning. The second cannot be so readily modeled, which is one reason why reductions in ignorance (and innovation) tends to be neglected in most economic analysis. Eliminating ignorance involves a quite different process of learning than increased statistical sampling does.

Recall that the posterior probability of event s, given that m has occurred, is the probability of s times the probability of observing m, given that s is true, divided by the probability of event m.

$$P(s|m) = [P(s)\, F(m|s) / F(m)\,]$$

If the probability of s is initially assigned a value of zero, $P(s) = 0$, whether implicitly or explicitly, the posterior probability will always be zero whatever the actual probabilities of m and m given s may be. This holds regardless whether P(s) is assumed to be zero or if one is totally ignorant of the existence of s and so no probability is assigned to s. That is to say, Bayesian updating allows refinements of theories (which can generally be represented as conditional probability functions) over events that are known to be possible, but not over events completely ignored or completely ruled out a priori.

Learning these "missing dimensions" involves a reduction in ignorance that is fundamentally different from Bayesian updating and similar statistical representations of learning. Priors are not updated when ignorance is reduced, but, rather, new priors are created for previously unrecognized possibilities.[40] The

[40] Binmore (1992, p. 488) suggests that a complete list of the possible outcomes is not even conceptually possible or at least is beyond the capacity of real decision makers. Frydman (1982) argues that agents cannot generally compute optimal forecasts in competitive markets, because they cannot estimate the forecasts of all other agents.
Cyert and DeGroot (1974) provide one of the earliest analyses of the relationship between Bayesian learning functions and rational expectations. Cyert and DeGroot note many cases in which Bayesian learning converges toward rational expectations and market clearing prices. However, they also note several failures

assumption that persons are ignorant of relevant conditioning variables implies that unknowns are associated with every decision, and that mistakes are made more or less routinely. "Unbiased" estimates and perfect decision making is impossible unless ignorance does not cause biased estimates of future events or probabilities of those events. In areas in which missing variables are important, rational decision makers make systematic errors because they are ignorant of relevant variables and relationships.

Here it bears noting that scientific progress in the usual sense of the word implies that ignorance is being reduced, e.g. breakthroughs are occurring, not simply that priors over known phenomena and relationships are being adjusted. The caveman did not know what a helicopter was; nor could he have explained how fiber optic cables operated or, for that matter, why the sun rose each morning.

Ignorance, nonetheless, does not rule out rational behavior. Rational choices remain possible in the sense that all the information available to decision makers is taken into account and the best of all known possibilities is chosen.[41] Ignorance simply implies that the list of possibilities considered may be very incomplete and that an individual's understanding of causal relationships (the conditional probability distributions between current actions and future events) may be erroneous in many respects.

Together, these imply that systematic mistakes can be made and surprises experienced by even the most careful and forward-looking decision makers. The farmers of 4,000 BCE did the best that they could, given their theories, but did not manage their fields in the most effective way possible. Nor, were they irrational when they adopted plans based on ignorance of the weather or flood levels of the rivers near where they farmed (nor presumably are today's farmers when they make similar errors). Such decisions might be said to be instances of "bounded rationality" in the sense that they are informationally bounded. However, they are not necessarily "bounded" because of lack of computational power or systematic failures of the mind, as is sometimes implied by the researchers who employ the bounded rationality concept (Conlisk 1996), but rather because so much is unknown to decision makers at the moment that choices and plans are made.

Optimization with Missing Conditioning Variables

The model developed in the chapter was done in a discrete table in order to minimize mathetical distractions for readers. However, for those concerned with the "discreteness" and discontinuities of the illustration, an illustration in a more tractible (continuous and differentiable) environment is developed below. The conconclusions are very similar to those generated from the model in table 4.1.

(inconsistencies) in cases where the original model used by individuals (firms) is incorrect.

[41] The quality of individual decision making may also be affected by intense emotions, such as fear or anger, that reduce the quality of rational decision making, but these effects are neglected in the present analysis.

Suppose that individuals maximize a strictly concave utility function defined over their own private consumption, C, and personal health, H,

$$U = u(C, H) \qquad (1)$$

Suppose that an individual's health, H, is a random variable that is affected by his or her own private expenditures on health care, E, and other costly personal (or governmental) decisions that reduce known health risk, R. Healthcare expenditures are undertaken only in the case of illness, and so can be regarded as an instance of self-insurance. In addition to these two known control variables, suppose that an individual's health is also affected by risk factor Z.

R, E, and Z are in most cases long vector of known, unknown, and neglected variables, but for the purposes of the model, each is treated as a single variable. And, only Z is assumed to be unknown (or unobserved) to the individual making the choice being modeled. Each combination of E, R, and Z creates a (conditional) probability function for health states.

$$f(H) = h(H \mid E, R, Z) \qquad (2)$$

Personal income Y is assumed to decline as steps to control known health risks are taken (avoiding contested lands, consuming fresh foods, drinking only clear water, personal hygiene, exercise, etc.).[42] A similar reduction would occur if the risk reducing rules were adopted and enforced through governmental regulations or conditional taxes, but analysis of such policies is postponed until part II. An individual's personal opportunity set for private consumption and health care in this case can be written as C = Y(R) - E.

Assume further that individuals maximize expected (average) utility and so select their risk reducing efforts and health-care expenditures to maximize,[43]

$$U^e = \int h(H|E, R, Z)u(Y(R) - E, H)dH. \qquad (3)$$

Differentiating equation 3 with respect to E and setting the result equal to zero allows the expected utility-maximizing level of health-care reserves for a given level of care, *R*, to be characterized as:

$$\int [h_E U - hU_c]dH = 0 \qquad (4a)$$

Equation 4 in conjunction with the implicit function theorem implies that the private demand (conditional plans) for health care can be written as

$$E^* = e(R, Z) \qquad (5.0)$$

[42] Across some range, personal income may increase as R increases, insofar as improved health improves productivity in the workforce. However, when R is set at approximately the level that maximizes utility, R will be increased until it is in the range in which R decreases personal income (see below); thus, for expositional and analytical convenience, Y_R is assumed to be less than zero across the range of interest.

[43] Sufficient conditions for strict concavity are $U_C > 0$, $U_H > 0$, $U_{HC} > 0$, $U_{CC} < 0$ and $U_{HH} < 0$. In addition to the strict concavity of U, it is assumed that the marginal return from private health care is reduced by effective regulations, $H_{ER} < 0$, and increased by risk factor Z, $H_{EZ} > 0$.

with

$$E_R^* = \left(\frac{\int [h_{ER} U + h_E U_c Y_R - h U_{cc} Y_R] dH}{-[U_{EE}^e]} \right) < 0 \qquad (5.1)$$

$$E_Z^* = \left(\frac{\int [h_{EZ} U] dH}{-[U_{EE}^e]} \right) > 0 \qquad (5.2)$$

with $U_{EE}^e = \int [h_{EE} U - 2 h_E U_c + h U_{cc} Y_R] dH < 0$

As individuals take more precautions, they put aside less for health-care reserves. As risk increase because of unknown shocks, once those new risks are recognized, reserves will be increased.

In cases in which both the level of care and health care reserves are determined simultaneously, equation 3 should be differentiated by both R and H, the results set equal to zero. Together with implicit function theorem, equation 7 implies that both the level of care and the health-care reserves are implicitly determined by variable Z, because Z determines where the expected marginal benefits of risk reducing behavior and health-care reserves equal their expected marginal costs:

$$E^* = e(Z) \qquad (8a)$$

$$R^* = r(Z) \qquad (8b)$$

The individuals of interest, however, are assumed to be ignorant about risk factor Z, so function r(Z) cannot directly determine and individual's either risk reducing behavior or health care expenditures. It does so indirectly by determing the probability function of health states, as understood by the individuals in question.

Z has direct effects on the marginal returns to health expenditures, H_E and risk reduction, H_R. As long as Z remains at a steady state, $Z = Z^o$, These returns may be known with certainty. In such cases, $E^* = e(Z^o)$ and $R^* = r(Z^o)$ can be adopted without any knowledge of Z.

Only in such cases, does ignorance of Z fail to reduce the effectiveness of private or public plans.

Effect of Discoveries

Ignorance of Z, however, can be a significant problem that leads to systematic errors in both public and private decision making if Z is not completely stable. For example, suppose that Z increases from Zo to Z' and produces an unobserved increase in the marginal returns from government policies to reduce health risks and to private risk reducing expenditures. Such changes might go unnoticed if data on H_E and H_R are collected infrequently or if small changes are neglected. H is stochastic and thus minor fluctuations in the effectiveness of risk reducing policies may be discounted as unexplainable random effects.

As long as the changes generated by the new level of Z are not recognized, the original policy remains "optimal" given the information available to decision

makers, but no longer best advances their true interests. The unnoticed change in Z implies that equations 4 and 8 are no longer be satisfied at $R^0=r(Z^0)$ and $E^0 = e(R^*, Z^0)$. Losses accumulate, but there is no crisis because no attention is focused on policy reform. People are less healthy and/or comfortable than they would have been with more complete information, but they do not yet realize this.

The rate at which unnoticed losses accumulate under the individual's standing choices (strategies or policies) is:

$$\Delta U^e = \int h(H|E^0, R^0, Z)u(Y(R^0) - E^0, H) - (H|E', R', Z)u(Y(R') - E', H)dH \quad (9)$$

where $R^0 = r(Z^o)$, $E^0 = e(Z^o)$, $R' = r(Z')$, and $E' = e(Z')$.

The urgency of the need to adopt plans that account for Z varies with the magnitude of the losses that accumulate under new values of Z. The higher the rate of perceived losses, the greater is the urgency. In many cases, the losses are so great that they are life threatening. In others, the losses are minor, and little urgency exists.[44]

Can Crises Be Anticipated?

Many other cases fall between these extremes. Some outcomes can be potentially controlled, yet present knowledge may be insufficient to do so. The results of efforts to do so might appear to be effective or ineffective. For example, Praying for the sun to rise tomorrow, might always be associated with sunrise the following day, without actually affecting the sun rise itself. Praying for better weather next year, would not for individuals and groups to take steps to increase average returns, reduce downside risks, or cope with the unpleasant surprises as yet unaccounted for.

A Suggested Shift in Focus From the Standard Neoclassical Approach

Social science tends to focus on the parts of life in which our routines work well, because these areas of life are easiest to understand. An economist would, for example, predict that in ordinary times, people save and spend a more or less constant fraction of their income and purchase a more or less constant--equilibrium--amount of clothing, food, and transport services. Changes in one set of familiar circumstances to others, will cause routines to shift in a more or less predictable manner. An increase in gasoline prices relative to income will tend to cause persons to adjust their routines in a manner that reduces gasoline consumption. Less driving may occur, smaller cars may be purchased, and more mass transit and bicycles may be used.

Such models and their associated theoretical structures indirectly suggest that risk is a bit of froth about an essentially predictable process that can account for most behavior. However, most empirical work in microeconomics suggests that such models can account for only about half of the variation in prices, outputs, etc.. The unexplained residual implies that persons using conventional models will

[44] Urgency may exaggerated in cases in which panic or terror is generated by the sudden changes in perceived health risks associated with disease or attacks. In effect, Z' may be mistaken for Z", with Z" >> Z, or relationship $H_Z < 0$ may be misestimated because of the scarcity of information about current and past values of Z.

confront both risks and uncertainties, when making plans for the future. It also suggests that a significant portion of what drives decisions is missing from the models.

Although, many issues can be clarified by ignoring risk and focusing on stable equilibria, the importance of risk and uncertainty on private and public choices is obviously neglected by such analyses.

However, if exogenous shocks (surprises) occur more or less regularly, but not predictably, they will also affect the manner in which people make decisions and behave. For example, decision makers will be less confident of the completeness and optimality of their plans than the mainstream models imply. As a consequence, they will tend to adopt more flexible plans, ones that can adjusted at various margins than the standard rational choice models suggest. They will also be looking to improve their plans, a task which is impossible in the standard models. And, as developed in Chapter 3, they are likely to maintain reserves or unused lines of credit, rather than allocate all of their resources as normally assumed. These aspects of choices under uncertainty may not be very important for some decision settings, but in others they will be the main consequences of the choices made.

Part II

The Politics of Risk and Crisis Management

"To this war of every man against every man, this also in consequent; that nothing can be unjust. The notions of right and wrong, justice and injustice have there no place. Where there is no common power, there is no law, where no law, no injustice. Force and fraud, are in war the cardinal virtues. ... No arts; no letters; no society; and which is worst of all, continual fear, and danger of violent death: and the life of man, solitary, poor, nasty, brutish and short." (Thomas Hobbes, 1651, *the Leviathan*)

Among the many objects to which a wise and free people find it necessary to direct their attention, that of providing for their SAFETY seems to be the first. The SAFETY of the people doubtless has relation to a great variety of circumstances and considerations, and consequently affords great latitude to those who wish to define it precisely and comprehensively. (John Jay, *Federalist Papers* (3), 1787 [emphasis in the original].)

Chapter 5: Governance, Uncertainty, and the Law

> Man, as a physical being, is like other bodies governed by invariable laws. As an intelligent being, he incessantly transgresses the laws established by God, and changes those of his own instituting. He is left to his private direction, though a limited being, and subject, like all finite intelligences, to ignorance and error: even his imperfect knowledge he loses; and as a sensible creature, he is hurried away by a thousand impetuous passions. Such a being might every instant forget his Creator; God has therefore reminded him of his duty by the laws of religion. Such a being is liable every moment to forget himself; philosophy has provided against this by the laws of morality. Formed to live in society, he might forget his fellow-creatures; legislators have therefore by political and civil laws confined him to his duty. (Montesquieu (1748 /2009). *The Spirit of Laws*)

A. Introduction: Governance as Risk and Crisis Management

Individuals and groups organize for a variety of practical reasons. Organized groups can solve a variety of coordination and externality goods problems by creating and enforcing artificial incentive systems. Large organizations and networks of smaller organizations benefit from specialization and risk pooling.

In a setting in which only measurable uncertainties exist, a group's procedures and routines can, at least in principle, be optimized. Once accomplished, these optimal routines and procedures will specify responses to both internal and external problems that maximize the organization's reserves and thus its prospects for survival and the potential benefits of continued membership. A single, perfected, organizational constitution can be left in place forever, just as a persons can flourish with a single lifetime plan in such circumstances.

However, in setting in which all possibilities are not known beforehand, surprises and unplanned for contingencies will arise. And, many of these will require revisions to old plans or totally new plans that limit unexpected losses or realize unexpected gains. Optimization in the presence of unmeasured and unmeasurable uncertainty at the level of organizations requires multiple decisions, just as it does for individuals. In such circumstances, organizations will have to be able to adapt is they are to prosper and/or survive in the long run.

The process through which such choices are made by organizations will referred to as governance for the rest of this book, and the subset of persons in the organization with the authority (or ability) to make such revisions will be referred to as the organization's government. Governance, like rational thought, is one of the major adaptations to the existence of potentially measurable uncertainty that is not yet understood and to unpleasant surprises requiring innovative responses.

Within large organizations, responsibility for governance tends to be specialized and hierarchical. Among specialities, there are the managers, whose job it is to respond to new emergencies or new opportunities by reallocating the resources under their authority and to seek additional resources from higher levels. At the top of the hierarchy are teams that can make rules (standing procedures) that bind those below them. Although all persons in such managerial positions participate in an organization's governance, it is the top level that is normally

referred to as an organization's government, and for the most part that is the case in this book as well.

Discretion among levels of managers exists because it is known that some surprises will call for fast innovative responses that depend on local conditions. The scope for such responses varies by level of management, which helps to limit risks from those responses. The greater the shift away from standing practices that have worked well in the past, the more likely mistakes are to be made, and the larger the losses may be from those losses. Thus, discretion over responses is more limited as one goes "down" the managerial hierarchy.

Skill and experience at crisis management tends to vary and, so, the most discretion is reserved for those who have proven best at it. At a low levels, a manager may assign persons or equipment to deal with the problems (e.g. revise short term rules and procedures), but not the longer term framing rules that he or she operates under. At the highest level of governance, all the fundamental goals and rules of the organization may be revised, although there are still good reasons to avoid major reforms, as developed below.

Many economic analyzes of hierarchies within firms stress the monitoring rather than managing responsibilities of managers. Monitoring, however, is largely an effort to makes sure that persons at lower levels are carrying out their duties and so solve problems (unpleasant surprises) rather than cause them for the organization.[45]

[45] See for example Rubin (1978) or Kaplan and Stromberg (2001).

B. Uncertainty and the Nature of Organizational Governance

As external circumstances change, organizations that have routines for adjusting their team's production to take advantage of the new circumstances will tend to do better than organizations that do not.

To adapt to new circumstances, organizations require somewhat flexible rules and procedures. Thus, very long term commitments tend to be avoided, and most contracts allow one or both parties to escape their obligations in unusual circumstances. Well developed futures markets exist only for deliveries and prices over the course of a year or two. Tenured teachers and professors can be fired for cause and because of financial problems. Long term contractual relationships tend to have more escape clauses, except in cases in which laws or the nature of the service (as with life insurance) prevent such flexibility.

Similarly, reward systems that can induce their teams to be more effective in new circumstances will tend to dominate those that cannot. Thus, wages and salaries are normally contingent on "performance," where performance may be redifined during the term of the contract and may partly a consequence of external circumstances (market prices for outputs). Performance criteria may be adjusted at the margin to encourage somewhat different behavior or methods of production that enhance profits or limit losses that would otherwise be borne by the organization.

Insofar as particular standing rules and procedures have proven to manage risk and crises better than others, there will be common features of institutional designs in large organizations. For example, governments use similar methods for

detecting surprise events inside and outside their organizations (or territories), and for responding to those events. A "big problem" is brought to the attention of more senior management, who determine whether the problem is real or not, and if so, how it should be managed.

Essentially every large, durable, organization has a body of internal procedures for making policy decisions that serve as its charter or constitution for governance. The standing rules normally specify: the officeholders who participate in major decisions, the manner in which those officials interact to make decisions, and how those persons are selected for their offices. The standing procedures of long-lived organizations also include rules governing the selection and succession of officeholders, and standing procedures for modifying the organization's charter. Skill and experience at crisis management tends to vary and, so, the most discretion is reserved for those who have proven best at it in a variety of circumstances.

.Many of the policy making groups will be based on the "king and council" template, for reasons discussed in Congleton (2011) and later in this chapter.[46]

Institutional Stability

Flexibility allows organizations to potentially change their policies and decisionmaking architecture at every instant. However, *durable organizations do and will not do so, because excessive adjustment is itself a source of problems and uncertainty.*

Organizations benefit from reducing uncertainty for their team members, support, and trading networks. Team members whose rewards become too uncertain will leave for other teams that offer similar rewards with greater certainty. Durable organizations thus tend to have standing policies for recruiting and rewarding team members, because it is in the interests of most organizational governments to have predictable policies on these matters.

The core procedures for making organizational policy decisions also tend to be stable, partly because of advantages associated with predictable policies, and partly because governance stability reduces unproductive internal conflict. Reward and governance systems are only adjusted in circumstances in which the benefits are expected to exceed the cost of lost predictability.[47]

The adjustments by organizational governments tend to be "piece-wise," focused at solving particular problems, rather than reinventing the organization. Just as economic and other theorizing works best in an "other things being equal" environment, so do policy and institutional reforms.

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[46] In cases in which errors are made in detecting disobedience, the expected payoffs will have a similar probabilistic structure. In this case, there will be some probability that an obedient team member will be punished (receive Z) rather than rewarded. And there will also be some probability that a disobedient team member will be rewarded (receive R) rather than be punished. Monitoring also tends to reduce the cost of compensation systems. See chapter 4 below.

[47] An interesting example of how economic organizations may benefit from predictability is the case of pricing. Firms have incentives to adjust their prices more slowly than technologically feasible, because it tends to increase sales. In effect, such firms "insure" their customers from fluctuations in input prices and so encourage greater sales. In an extreme case, Coca Cola held its price for cola at 5¢/6.5 ounce bottle for more than seventy years (Levy and Young, 2004).

Such modest reforms preserve advantages associated with existing procedures and avoid unforeseen costs generated by large policy and institutional experiments. Although many such changes may be proposed and evaluated, only a few will be adopted, because of the risks associated with them.

Organizational governments face a continuing stream of decisions to be made. Should "we" continue what we are doing or change, and if the latter, how so? Because not every problem or opportunity can be analyzed simultaneously, a common decisionmaking procedure is to group problems into more or less independent and separable subsets that can be dealt with one at a time. After such problems sets are identified, they can be ranked from most important to least important (from those most likely to those least likely to affect formeteur interests significantly).

This allows the time and attention of policymaker-managers to be efficiently allocated among problem sets. Information is gathered and analyzed, as necessary, to rank both problems and alternative solutions for the problem class at hand. When this is done perfectly, the most important decisions are made first, the second most important second, and so forth.

If circumstances appear to be stable and few obvious mistakes have been made, past decisions will be left in place. Past decisions need to be revised only when new problems emerge or new relevant information becomes available. The result in durable organizations is a series of standing policies and rules that remain in force for significant periods: an organizational "law of the land."

Why Organizational Governance Are Neglected by Economists, But Should Not Be

The standing procedures for making policy decisions within organizations have attracted far less attention by economists and other rational choice analysts than have their internal incentive systems. For example, Williamson's widely read books on corporate governance (1975, 1987), implicitly assumes that the institutions for choosing policies are already well-known, in place, and essentially automatic. The same could be said about Alchian and Demsetz' (1972) analysis of team production, Vicker's (1985) analysis of delegation, and Laffont and Tirole's (1993) analysis of relationships between firms and between government regulators and firms.

A partial defense of that neglect is that an organization's government is often an instance of team production. In most cases an organization's standing policies are jointly produced by several team members. Information is collected about internal and external circumstances, the information analyzed, alternatives evaluated, and decisions made. In only the simplest of organizations and circumstances is all this done by a single individual.

As a consequence, those participating in organizational governance normally have "artificial" incentives that are largely determined by the organization's standing system of rewards, because the usual problems of team production have to be overcome to create an effective organizational government. However, an organization is more than an incentive system.

The "outputs" of an organization's government are very different from those of its other teams. An organization's government essentially produces the organization itself and revises it through time. It determines whether a

cherry-picking firm will continue to pick cherries, whether a pear harvesting coop will switch to apples, and whether a fishing club will shift from fishing to shipping, and, if so, it determines which ships will head which port cities, and substantially what and who will be on board them. The ruling body of a regional government determines what will be taxed, who will collect the taxes, and whether to expand ts territory by invading its neighbors or not. As a consequence, there are informational, collective choice, and bargaining aspects to organizational governance that are absent, or much smaller, for other teams within large organizations.

C. Risk Management in Territorial Governments

Of particular importance for the main purposes of this book are the subset of durable organizations that govern territories. When the above analysis is applied to territorial governance, it implies that governance will tend to be rule bound, but flexible, and that policymaking authority is likely to be shared in practice, rather than vested in a single person or committee. This contrasts with most pure models of dictatorship and democracy analyzed by most political scientists and political economists. It also challenges the practical relevance of political theories that rely on or defend undivided sovereignty, such as Hobbes' (1651) theory of social contacts.

Many governments have architectures that are drawn from the "king and council template," because that template solves a variety of long term governance problems that arise in settings of uncertainty. The king and council template provides several robust solutions for succession problems and also allows authority to be shifted between the king and council in a manner that can improve organizational decision making in response to external and internal surprises. Authority, veto power, and methods for selecting members can be varied in a variety of ways that create a continuum of governance that can be "finely tuned" to take advantage of new circumstances and the talent and skills of the members of the organizational government, without changing the fundamental architecture of the organization's government (Congleton 2001, 2011).

It is the main tasks undertaken by governments, however, rather than their form, that is most central to the focus of the present book.

What exactly is it that most governments do? And why to they do what they do? The organization of territorial governments nonetheless has effects on the latter, insofar as the organizational structure determines how office holders come to office and the steps that they should take to continue and prosper in office. One of those is especially relevant for the purposes of this book, namely the difference between the incentives of unelected king-dominated versions of the king and council template (dictatorships) and ones in which all members of government are broadly elected. Although Managing risk and uncertainties tends to be central to all governance, the types of risk that attract greatest attention tend to vary with governmental type.

In authoritarian regimes, two types of risks tend to attract the most attention: (1) those that threaten the authority of rulers (security risks) and those that threaten the fruits of office (income risks), roughly in that order. Mancur Olson (xxxx) among others has noted that royal income can be increased by providing a variety of public services, including law in order, although in some cases, there may

be a conflict between increasing the taxable income of one's subject and security risks (Congleton xxxx), and so income tends to be less than that which maximizes tax revenues.

In democratic regimes, reducing the risk of "overthrow" requires pleasing a majority of voters, whose interest in risk and crisis management may differ from that of authoritarians. Nonetheless, the analysis of part I of this book strongly suggests that voters have strong interests in risk and crisis management services, especially for risks that they have not satisfactorily managed or insured.

Thus, one does not have to accept with Hobbes' social contract theory to argue that governments--both authoritarian and democratic--tend to focus most of their resources on the risks associated with life in communities. Even without the threat of a war of every man against every other, there is a constant demand for "security" increasing rules and services by the rulers themselves, by interest groups, and by voters. The remainder of the book focuses on why and how such services are provided by government, beginning with rules securing persons and property.

D. Civil Law as Risk Management

From the earliest days, it appears that agriculture based societies had what might called civil laws, laws that protect individuals from attack and enslavement and basic property laws that assign rights to use, harvest, and exclude others from a particular piece of "property" to individuals, families, or small groups. The history of property law suggests that they were often adopted to address commons problems and other analytically similar problems associated with long term investments. Much of the productivity of property law, especially for unproduced resources, evidently arises through reductions in losses from over use and/or under investment. Uncertainty about claims on future outputs from particular resources can undermine strategies that are optimal in the long run, and encourage short run extractive strategies that undermine long run results.

Whether the existence of laws dealing with property and persons reflects and ancient contract, an innovative dictator, or evolutionary forces is less important than the fact that such rules exist in most authoritarian and democratic polities. This suggests that property and person laws benefit authoritarians (larger tax base), interest groups (greater wealth), and voters (greater wealth and security).

Property Law as a Method of Risk Management

In the abstract models used by economists, the price system alone is often sufficient to generate efficient outcomes at which all potential gains from trade are realized. That is prices induce sellers to bring supplies to the market in the pursuit of profit and causes buyers to arrive with the expectation of personal gains from trade (consumer surplus and profits). The traders in an "Edgeworth Box" simply maximizes their own utility by attempting to get the best combination of goods (the utility maximizing combination), given market prices. The prices are often, in effect, simply called out by "the auctioneer" they make decisions about whether buying or selling most advances their interest.

However, in the real world the alternatives may not be limited to the simply "buy" or "sell" alternatives of an Edgeworth box. To limit choices to such "legal" choices implies that trades take place in a legal environment in which both modern Western property rights and contracts are enforced. The existence of an external

regime of laws is implicit in essentially all economic analysis. Similarly, the Solow-type growth models of the 1950-1990s suggests that economic development is all about capital accumulation. Essentially, the more capital a laborer has, the more productive he or she is and the higher GDP is.

However, economies with the same labor and capital may have produce quite different levels of GDP according to how they are employed. Moreover, institutions (law enforcement and private property rights) will affect incentives to save and invest in both human and physical capital.

In order to understand the contribution that property rights makes to economic development, let's consider first what might be called the dilemma of thieves.

Suppose that Al and Bob interact in a setting in which property rights are not enforced, so there is no penalty associated with attempting to steal property from one another. To simplify, suppose that each person controls several his or her own labor and can use that labor to either harvest nuts or to attempt to steal nuts gathered by the other person in the community and/or to protect his or her nuts from theft. To simplify even further assume that there are 4 blocks of time and that the use of time to defend one's own nuts or steal from the other are equally productive. This setting is represented with a game matrix (table 5.2) that is very similar to a Prisoner's dilemma game, although it has more than two strategies.

Since each person has an interest in maximizing their income (net benefits, utility), each person turns out to invest 3 hours in stealing nuts from the other or defending their nuts from the other. The result is a dilemma because too little time is invested in harvesting nuts. The total output at the Nash equilibrium is 3,3 which is far below that associated with no stealing. The dilemma is that each would be better off if each had spent all of their time gathering nuts rather than protecting their stash or stealing from the other.[48]

Table 5.2: The Dilemma of Thieves

Al's effort	Bob's effort stealing or defending: 0 hours stealing	1 hour	2 hours	3 hours
0 hours	12, 12	6, 13	3, 14	0, 15
1 hour	13, 6	9, 9	4, 10	1, 12
2 hours	14, 3	10, 4	6, 6	2, 7
3 hours	15, 0	12, 1	7, 2	3, 3

Payoffs are in bags of nuts, net benefits, or utility.

Many of the alternative payoff combinations are Pareto superior to the Nash equilibrium! Escape from this dilemma will require a change in incentives. Note that simply agreeing not to steal is not credible, because each has strong incentives to cheat on the agreement. One possible solution would be to "hire" a property right enforcer to punish persons whenever they spend time stealing. Note that Al and Bob can afford to pay for the enforcer up to 14 bags of nuts for a solution to

[48] This characterization of the dilemma of thieves neglects the role of uncertainty and surprise in such settings. Hillman and Samet (1987) note that rent-seeking contests with a structure very similar to that characterized above tend to have a mixed-strategy equilibrium when potential rent-seeking (here thieves) can choice between a number of contests (here persons or place to steal from).

their Hobbesian dilemma. (Explain why.) Note also that a penalty for stealing of just 3 bags of nuts per hour would be sufficient to discourage theft in most cases.

Another solution would be for a territorial government to supply this service and finance it with taxes on output. In the case of authoritarian governments, the tax rates for police services may be set to approximately maximize tax revenues. In the case of democracies, the tax rates may be set to cover their costs, in order to maximize voter income.

Avoiding Commons Problems

Another quite different problem in which granting persons rights to use and exclude others from particular pieces of property is the commons problem. Although a variety of solutions exist (Ostrom1990), one very common solution is to grant rights to use and exclude to particular people or families.

Why such rules increase income and potential tax revenues can be illustrated with another simple game matrix. Two persons, Al and Bob are assumed to have unrestricted access to a productive resources, which can be over used. That is to say, usage beyond some level reduces the output generated by the resource, as might be the case of fish in a pond, fruit in an orchard, or a water or oil well. Each person privately benefits as he or she increases her use, but that usage reduces the extent (or value) of the resource for the other. As each person chooses the best strategy for him- or herself, a Nash equilibrium emerges at which the common resource is over used and output is below that which it could be. Here the equilibrium output is 8 units (4+4), but up to 12 units of output could be obtained.

As a group, each person could potentially benefit from lower usage, but acting alone neither can achieve a better result than the Nash equilibrium.

Table 5.3: The Deterministic Commons Problem

	Light Use by B	Moderate Use by B	Heavy Use by B
	A, B	A, B	A, B
Light Use by A	4, 4	3, 7	2, 9
Moderate Use by A	7, 3	6, 6	3, 7
Heavy Use by A	9, 2	7, 3	4, 4

It bears that such privatization occurs even within families and corporations where persons are routinely assigned rights to "their" room, "their" water glasses, "their" seats at a table, without giving them the right to sell or rent out "their" room, glass, or chair. Such intra-organizational rights are enforced through various organizational sanctions and norms. Rules that assign durable "use rights" to an individual or relatively small groups allow resources to be used more efficiently and encourage long term investment.

The logic of the commons can be generalized in several ways, many of which add uncertainty to the problem. For example, usage may require investments to improve the resource in various ways, which may have stochastic rather than deterministic returns. The carrying capacity of the common resource may also be partly stochastic, as would be the case if it depends on weather or migration patterns.

Alternatively, common-like problems may emerge because of imperfect collective management of a common resource. The wrong rules being in place or may be improperly implemented or enforced. The collective decision process in

place may be problematic and the rules adopted may encourage over or under use the resource in question. A group may use inefficient decision rules (e.g. unanimous agreement or dictatorship) which make it error prone or slow to respond to new problems as they emerge. There are also free rider and rent-seeking problems associated with collective management that may undermine its effectiveness. Such problems may also be avoided through partial or complete privatization.

The privatization of use-rights tends to reduce decision costs and align interests so that the choices made are more likely to improve productivity. As every parent knows, partial privatization can also reduce unproductive conflict within families and communities. "That toy or seat is Alice's, not Bobby's" can end a good deal of conflict, and also helps assure that the stronger child does not simply take all the toys of interest. In such cases and many others, private property in the sense of management by a single person or small group, tends to outperform community management schemes.[49]

Such use or ownership rights and systems of punishment for violations of them are ancient. They have existed, as far as we know, from the days laws were first written down. For example, the Code of Hammurabi (1750 BCE), the legal code of an irrigation-based agricultural society in the Euphrates river valley, includes:

> If any one steals cattle or sheep, or an ass, or a pig or a goat, if it belong to a god or to the court, the thief shall pay thirty fold therefor; if they belonged to a freed man of the king he shall pay tenfold; if the thief has nothing with which to pay he shall be put to death.

Of course, not every common property resource is a disaster waiting to happen, which is why so much property continues to be held and managed by communities, clubs, partnerships, and families rather than managed by single proprietors. In some circumstances communal property may pool rather than increase risks, or allow economies of scale to be realized, rather than generate overuse and under investment. However, commons problems may emerge from time to time, as with Christmas parking at U. S. shopping malls, some of which may be severe enough to require solutions if a village or society is to remain viable. As new opportunities for productive usage arise or as the distribution of demands increase, it may become necessary to directly address commons problem through privatization or other management methods (Demsetz 1967). In such cases, new rules or laws may be adopted to reduce a broad range of risks for residents (and leaders) of the communities of interest.

It bears noting that in addition avoiding commons problems and reducing conflict, such rules also tend to increase the average output of the resources. Insofar as these can be stored or substitute for other goods that can be stored, solutions to commons problems provide additional resources that can be used to supplement "rainy day" funds. The larger such funds are, the more likely a community is to survive a variety of other nasty surprises, many of which are unrelated to commons problems. These benefits can be increased through

[49] Here it bears noting, that the choice is not always "either or" with respect to a particular piece of property--private decisions may control some uses, but community rules may determine others.

supplemental rules that allow resources to be permanently or temporarily transferred among persons as with inheritance, sales, and contract laws.[50]

Rules governing inheritance both reduce conflict at the death of property owners and also tend to induce a longer term perspective insofar as current owners take account of the interests of their children. Allowing use rights to be shifted (traded) from one person to another allows unproduced resources such as raw land to be shifted toward relatively more productive persons or organizations. It also tends to increase the supply of produced resources by encouraging producers to produce more output than they need for their own consumption. Trade also reduces private and community risks both by increasing reserves and by allowing persons to trade for products and services that they may not be able to reliably produce for themselves, or may at least occasionally find themselves without.

As trade expands the advantages of comparative advantage and specialization may be exploited to further increase in wealth, private and public reserves, and tax based for the regional government of interest. Adam Smith (1776) argued that specialization is the main engine of economic development and growth. Of course, specialization also brings risks, as discussed later in this chapter, but historically it has "paid off" more often than not. Communities with such property right systems have been more likely to survive and flourish than those without them in large part because, on balance, they reduce the risks associated with life in a community.

E. Torts: General Laws that Directly Reduce Risks and Accidents

In addition to rules that indirectly reduce risks, as may be said of property rights systems, other long-standing laws directly and explicitly address risk producing behavior. For example, criminal law protects a persons health and wealth by punishing those who would attack others or take their property. Within the civil law, tort laws reduce risks for the members of a community by making those who produce the risks or increase the probability of accidents liable for damages.

Tort laws rules induce fellow residents to take account of damages that their behavior causes or may cause, which induces them to exercise greater care than they would otherwise have undertaken. Criminal and regulatory laws, in contrast, use sanctions, rather than compensation for losses, to induce greater restraint on the part of those who are tempted to violate the civil rights of others, as with punishments for theft, destruction of property, assault, and murder.

Tort law is used below to illustrate how such laws change behavior in a manner that reduces risks associated with life in communities. Criminal laws operate in a more obvious manner to limit risks, but the incentive effects are fundamentally similar. Here one may note the rules for punishing the theft of agricultural animals in the code of Hammurabi quoted above.

[50] The deterministic commons problem can be solved in a variety of other ways as well. Usage norms may emerge under which groups with the "right" norms tend to use the commons at more productive levels. There may be communal management of the commons, and punishments meted out for folks who over use the commons. See Ostrom (1990) for an overview of the wide range of solutions to commons problem that have been used.

Tort law, for all of its subtleties, is also among the oldest parts of the civil code. For example, the Code of Hammurabi includes rules for assigning damages from accidents:

> If any one be too lazy to keep his dam in proper condition, and does not so keep it; if then the dam break and all the fields be flooded, then shall he in whose dam the break occurred be sold for money, and the money shall replace the corn which he has caused to be ruined. If he be not able to replace the corn, then he and his possessions shall be divided among the farmers whose corn he has flooded.
>
> If any one open his ditches to water his crop, but is careless, and the water flood the field of his neighbor, then he shall pay his neighbor corn for his loss.

If someone's dam broke and flooded his neighbor's fields, as a consequence of laziness (negligence), that person was liable for damages, but if unusually heavy rains rather than carelessness or laziness caused the flood, one was evidently not liable.[51] There is also a hint of negligence-based assignment of liability in the notion of "proper condition."

As noted in chapter 2, avoidable accidents happen, and in many cases the effects of those accidents fall on others in the community of interest. Liability laws such as those in the Hammurabi legal code and in contemporary civil law create incentives for the person "responsible" for the damages to take steps to prevent them. For the most part, the person causing the accident has to pay for the damages that his decisions (indirectly) impose on others in the community.

In cases in which causality is unidirectional from the person whose neglect caused the accident to the damages borne by those affected by them, such laws induce "efficient" levels of care, which tends to maximize the net advantages from that care for both the person's undertaking the care and the persons benefiting from it. Communities with such rules will prosper and/or survive more calamities than those who do not. In this respect, the strict liability rule works like a Pigovian solution, but only in cases in which causality is "one way."

Table 5.4: Tort Law and Risk-Reducing Investments

Precautions Undertaken by Al	Al Net Benefits, Damages on Bob
	A, B
No Precautions by A	*10, 10*
A Few Precautions by A	9, 7
Moderate Precautions by A	**8, 4**
Heavy Precautions by A	5, 2
All Possible Precautions by A	2, 1

Table 5.2 illustrates how liability for damages affects those whose actions generate the risks. The table represents a setting in which Al undertakes an activity that generates a known level of net benefits but with some chance of damaging his or her neighbor Bob. Without tort law or an equivalent inducement, Al would take no precautions, because this maximizes his net advantage from the activity undertaken, although it imposes significant risks on Bob. If, on the other hand, Al knows that he or she will be liable for damages to Bob, he will spend money on

[51] Such laws may be especially important for "weakest link" technologies as dikes tend to be. A failure of the weakest link (as in a chain) may cause an entire system to fail with catastrophic consequences for an irrigation based community. [TN Tideman pointed this out as we were discussing an early draft of chapter 5.]

risk reducing precautions up to the point where they reduce Al's damages by less than they cost, thus minimizing the cost of precautions and damages. In this case, All will undertake moderate precautions which, net of damage payments to Bob, maximizes his net advantages of the activity generating the damages.

Tort laws are only one of many areas of law the explicitly attempt to limit risks. That both tort and criminal laws protecting property and persons are commonplace suggests that such efforts to manage risks has advantages for both rulers and those who live in their communities. Without such rules, it is unlikely that communities could attract sufficient residents to be viable or have sufficient resources (tax receipts, manpower etc) for governments to protect their communities from roving bandits and the annexing efforts of their neighbors.

F. The Evolutionary Advantage of Civil and Criminal Law

For the purposes of this book, such rules are of interest for several reasons. First, it is clear that by encouraging persons in the community to exercise greater care, tort rules tend to reduce risks associated with living in that community, and thereby make communities more viable, but making life in them more attractive. It bears noting that such rules were adopted by communities or community leaders without knowing any of Alfred Pigou's insights about externalities. The survival advantage of such rules is sufficient to account for their existence. Communities do not have to fully appreciate their value to benefit from them in the long run.

Second, civil laws are often (although not always) written in a manner that implies uniformity in their application, not because the law has to be general in this sense, but because there are advantages associated with such generality. Towns, for example, normally need both labor and capital to be successful. The "generality" of the law is likely to be a consequence of efforts to attract and retain a broad range of residents and capital and of economies in administering more or less uniform laws, rather than any inherent "publicness" in the Samuelsonian sense. Personalized exceptions were often included, which demonstrate the lack of technological publicness in law or other rules, per se. Nobles and royal families, for example, historically have often benefited from special preferences in the law. Here one may note the differences in the punishments for theft from churches and the state and from freemen in the Code of Hammurabi.

Third, as a consequence of their productivity most of the core rules of the civil code and criminal law are more durable than the governments that enforce them, even though the rules are revised at the margin from time to time. The civil code of the United States has roots in English common law. The Napoleonic Code based civil codes (with roots in Roman law) used in much of Europe, similarly are older than their contemporary constitutional governments.

This is not to say that a long-standing civil code is incapable of improvement or completely static. Rules for assessing liability and for determining the bounds of property rights, for example, may be adjusted at the margin to account for changes in the risk structure of the accidents and threats as technology changes or the political power of persons affected by such rules. Nobles in Europe, for example, lost most of their legal privileges during the nineteenth century. Other reforms of the nineteenth century addressed new kinds of accidents associated with industrialization. For example, in a significant subset of the new accidents, the damages were jointly caused (or only partly caused), rather than the consequence

of the care exercised by a single person, firm, or organization. Many others that could not be avoided by exercising reasonable care (taking precautions). As a consequence, the negligence principle become a more central principle for assigning liability for accidental damages.[52]

G. Governance, Judges, and Regulation as Adaptive Risk Management

The use of general rules to reduce risks associated with life in a community has numerous advantages over case by case regulations. The most important of which is that it is impossible to list every possible risk, risk increasing scenario, or damage setting. General principles allow individuals in the community to "know" what the rules are--at least approximatly--for an enormous range of types of property, transactions, and accidents. However, at the various margins of those principles, ambiguities always exist. And, as new circumstances arise, whether they can be dealt with by existing principles is not always obvious or possible. In the former cases, new interpretations will be necessary. In the later, new legal principles or government policies may be necessary.

Many surprises simply require new applications of existing rules. New rulings are made for the new circumstances of the cases brought, and these precedents may be said to create the main body of the civil laws. Nearly every case brought before judges is a surprise, is a bit different from previous ones. Rather than wait for new rules to emerge from the government, responsibilities for interpreting how existing laws should be applied to new situations is usually delegated to judges or similar government officials. In this manner general principles adopted by "rulers" are "fleshed out" through relatively detailed and specific decisions that put the meat on the bones of legal principles. Such decisions are far less general and more fine grained than the principles applied to reach them.

For new problems (often risks) that appear to be beyond the scope of judicial discretion, the government may adopt new rules and regulations. In some cases, the processes of legislation and regulation may substitute for court decisions, but in many cases, they go well beyond those which normally arise in courts.[53] In the latter cases, the new circumstances--the surprises--are such that they are considered beyond of scope of the long-standing general principles of a communities body of law.

In such cases, it may be said that governmental policy makers, like individuals, engage in crisis management. In response, the rulers may adopt new laws, regulations, and rules, or they may simply adopt a temporary (emergency) policy that addresses the surprise at hand. Such adjustments are "one off" policies adopted to address a new problem. Emergency powers may be used to shift

[52] In cases in which only a subset of factors that contribute to the accident can be controlled, a strict liability rule can induce too much (overly costly) care, because one person or organization is held liable regardless of whether he or she could have reduced the average damages or not, and regardless of whether others contributed to the damages. The negligence rule holds a person liable for damages caused by an accident, only if he, she or it failed to exercise "proper care," the care that a "reasonable man" would have adopted. Beyond some point, the factors that cause an accident may not be controllable or may cost more to control than damages are reduced. Note that the code of Hammurabi held the owner of a dike liable for damage from poor dike maintenance, only if he had "properly" maintained it. See chapter XX for more on the industrial risks solved through negligence rules for assigning liability.

[53] See, for example, Shleifer (2012) for a discussion of how regulation may substitute for civil law when it fails to work as moderate voters wish.

resources within government from one to another purpose without folloing normal decision routines. Or, private resources may be shifted from one purpose to another in a manner that violates ordinary civil law. Because the government makes and enforces the law, it is rarely the case (historically) that governments are completely bound by those laws. During wars, governments may commandeer private resources for defense. During a flood, it may be useful to destroy a private or community dike to protect others or to evict persons from their homes to save lives and reduce anarchy.

After a crisis is over, longer term policies may be adopted with the aim of reducing the likelihood of similar events in the future, improving responses to such events when they occur, and limiting risks associated with them. Or, there may simply be a return to the pre-crisis routines and laws. Both results--new laws and standing procedures for temporary emergency powers--are often quasi-constitutional in nature in that they remain in place for long periods of time, and may be modified only when the next crisis emerges. See chapter xx for more on the political economy of crisis management.

What is important for the purposes of this chapter is that many of our laws and interpretations of those laws are driven by risk managment and a long series of new (surprising) circumstances that call for standing procedures and rules to be revised or extended. The result tends to be a complex series of rules of the "if X than R" variety, but where the "X" can be incredibly detailed and often entirely new, at the same time that response R is also relatively complex and subject to revision. In this manner, risk and crisis may be said to be primary drivers of the evolution of both public and private rules.

Chapter 6: Differences between Authoritarian and Democratic Rules

That many formal rules are adopted to manage risks is true of all governments; however, the risks that attract the most interest from government officials varies among political institutions. All government officials have an interest in holding on to office, in pursuit of what some economists call "ego rents" and others as the fruits of office, fruits that can only be obtained through control over public policy. Retaining office requires overcoming risks that are largely determined by the institutional framework in which they operate.

To retain office, authoritarians regimes have to avoid invasions, popular revolutions, and palace coups. Olson (xxxx) suggests that much of the productivity of authoritarian regimes arises from their success at avoiding invasion. Tullock (1974) suggests that avoiding popular revolts is relatively easy to do, but avoiding palace coups tends to be problematic, because palace coups are relatively easy to organize and difficult to detect. Avoiding such risks are personal and central to continuing office. In addition to domestic risks, authoritarians may also face border and conquest conflicts that they need to succeed at. With these "security" risks in mind, authoritarians tend to have relatively large armies and secret police forces, and tend to punish anti-regime speech and organizations as instances of treason. By doing so they increase the risks associated with revolt and conspiracy and reduce their frequency.

Note that being right about conspiracies is less important than avoiding being wrong, and so the risks for innocent (loyal and neutral) persons, with social ties to governmental critics, may be significant as a consequence. In this area of lawful governance, erring on the side of repression is a strategy for reducing the risk of regime change, and both particular ideas and threatening groups--indeed thoughts--are actively suppressed.

However, this does not imply that governance by authoritarians is worse than all other possible forms of government. The position of rule-makers at the apex of society allows provides them with good economic reasons to promote economic growth and development as long as it does not conflict with regime preservations. They are, in effect, residual claimants on their nation's social surplus. Thus, as Olson (1993, 2002) suggests, a "safe" autocrat tends to invest in civil and criminal law, infrastructure, and education to the extent that such services generates a larger tax base and thereby provides resources that can be used to address an authoritarians security risks and, of course, to build palaces and so forth for his personal amusement.

Less safe or confident rulers, however, will be more concerned with the risk of overthrow than with long term tax revenue. Moreover, they may expect to lose office in the near term and focus on building personal reserves outside the country in order retire in comfort and safety abroad. Such rulers are less interested in long run returns than command over resources in the short run, and their territory's potential for long run growth will be ignored.

In contrast, the risks faced by elected office holders are not mainly addressed through various security measures. Instead of Hobbesian risks of overthrow, they face institutionally created risks, namely regular elections. These risks are not to be overcome through legislation or other means (although office holders often try to do so, and occasionally elected office holder succeed in becoming authoritarians),

but rather by securing favorable outcome in a permanently risky situation. Elected office holders have to repeatedly win elections to hold on to their authority over laws, regulations, and other public policies.

Regular elections tend to induce a short run perspective on the part of elected office holders, but that perspective tends to align their interests with those of moderate voters according to the median voter theorem. Thus, the time horizon and interests that determines policies becomes that of moderate voters rather than those of the persons holding office (Downs, xxxx, Congleton xxxx). In this manner, the institutionally contrived risks of democratic governments attempts to produce policies that advance more general interests than those advanced by authoritarians.

If this is so, it must be the case that moderate voters have interests that are neglected by authoritarians. Here one may note that even the best of authoritarians will neglect mainstream interests that do not affect or that conflict with economic growth rates. For example, authoritarians have little reason to adopt rules that increase food or workplace safety or to address environmental problems unless such rules increase the size of their tax bases in the long run.[54] Moderate voters, in contrast to dictators, may well be willing to pay a growth price to have such risks reduced through regulation. Similarly, social insurance programs will typically be of greater interest for voters, even if it is anticipated that the taxes required to pay for them will somewhat reduce long run growth.

Moreover, voters may demand greater accuracy from their judicial systems insofar as it it they how bear the risks from wrongful decisions. In such cases, one would anticipate more reviews and more stringent rules for court proceedings in democracies than in authoritarian regimes.

Note that there tends to be greater overlap in the demands for civil and criminal law among authoritarians and democracies than with respect to political liberties. Each benefits as economic development occurs. Voters gain higher incomes and authoritarians broader tax bases. However, political liberties such as rights to associate and to free speech differ. Voters have a somewhat greater interest in such liberties, partly because it reduces their risks from poor governance, while authoritarians have more to fear from such liberties, insofar as they might plausibly lead to public revolts or stimulate palace coups.

Nonetheless, a broad range of the laws, regulations, and procedures adopted by both authoritarian and democratic regimes clearly attempt to reduce or eliminate various risks. That is to say, risk management is a central concern for authoritarians and voters, alike. But the risks of interest to voters tend to be different than those of authoritarians.

A. Some Evidence of Differences in the Rules Adopted by Authoritarian and Democratic Governments

In terms of economic development, the above analysis suggests that voters will find many areas of life in which they are willing to pay for lower risks either

[54] An early analysis of differences in the environmental regulations of democracies and dictatorships is provided in Congleton 1992. It bears noting that most recent international environmental treaties essentially bribe authoritarian regimes to adopt domestic environmental regulations through conditional grants of various kinds and by exempting most from the tougher standards of democracies.

through taxes or lower growth rates. Thus it is quite possible that a stable authoritarian regime with long term interests will grow more rapidly than a democratic regime. However, the analysis also suggests that less confident authoritarians are willing to pay an economic price for greater security if they face personal threats of assassination or overthrow. Indeed, if security concerns are great and the fruits of office relatively large, an authoritarian regime may be willing to completely undermine long growth in the pursuit of short term security, ego rents, and self insurance (foreign reserves) interests.

Contemporary evidence suggests that the short term security interests of authoritarians normally dominates their long term interests in economic growth. Consequently economic freedoms tend to be more limited than in democracies and economic growth and average income levels lower. The most authoritarian regimes have the fewest political and civil liberties, and tend to have a lower average income (per capita GDP) and slower growth than democratic regimes.

Evidence of the security-national income tradeoffs of authoritarian regimes is developed in Tables 5.3 and 5.4. Each table provides information about 25 countries. Table 5.3 focuses on countries with the highest per capita gross domestic product, calculated using World Bank data. Table 5.4 focuses on the poorest. All but five of the countries in table 5.3 have high levels of economic freedom according to the Heritage Foundation's measures. All but three have very low levels of corruption (locally illegal forms of rent seeking). The outlier in the table—Equatorial Guinea—has very large oil sales relative to its population and is the only country on this high-income list without relatively liberal economic and political institutions.

Table 5.3
The World's Highest Income Countries and Indices of Their Political and Economic Freedoms

Rank	Per Capita GDP	Civil Liberties Index	Economic Freedom Rank	Corruption Rank
1	Luxembourg	1	15	11
2	Norway	1	28	14
3	Singapore	4	2	4
4	United States	1	6	18
5	Ireland	1	4	16
6	Switzerland	1	9	5
7	Austria	1	23	12
8	Netherlands	1	12	7
9	Iceland	1	14	7
10	Sweden	1	26	1
11	Denmark	1	8	1
12	Canada	1	7	9
13	Australia	1	3	9
14	Belgium	1	20	18
15	Finland	1	17	5
16	United Kingdom	1	10	16
17	Japan	2	19	18
18	France	1	64	23
19	Germany	1	25	14
20	Greece	2	81	57
21	Spain	1	29	28
22	Eq. Guinea	7	142	171
23	Italy	2	76	55
24	Cyprus (Greek)	1	24	31
25	Slovenia	1	68	26
	Average	1.48	29.28	23.04

The GDP per capita rankings (using purchasing power parity international dollars)

are from the *World Development Indicators* database (2008) assembled by the World Bank. Civil liberty data from the *Freedom House* 2009 website (downloaded June 2009), economic freedom rankings from the Heritage Foundation's *2009 Index of Economic Freedom* (downloaded July 2009), and corruption rankings from the *2008 Corruption Perceptions Index* (downloaded from Transparency International's website July 2009).

Some other lists of high per-capita GNP nations include more oil countries than the one used above, but are otherwise broadly similar. Oil-rich nations tend to have lower scores on economic and political liberalism. These countries are not of interest for the purposes of this paper, because high per-capita geological endowments are largely matters of geological luck, rather than public policy or institutions that can be improved.[55]

Table 5.4 lists the 25 poorest countries and associated indices of political and economic freedom and corruption using the same data sets as in table 5.3. Note that all but four of these countries have repressive political environments (CLI > 3). All but four also exhibit restrictive economic environments (EFR > 100). All but three have very high levels of corruption (CR > 100). The sale of favors is evidently both a source or revenue and power for those in authority in these countries.[56]

Table 5.4
The World's Lowest-Income Countries and Indices of Their Political and Economic Liberalism

Bottom Rank	Country	Civil Liberties Index	Economic Freedom Rank	Corruption Rank
1	Rep. of Congo	5	166	158
2	Burundi	5	153	158
3	Liberia	4	157	138
4	Guinea-Bissau	4	165	158
5	Eritrea	6	175	126
6	Niger	4	128	115
7	Sierra Leone	3	158	158
8	CAR	5	156	151
9	Malawi	4	129	115
10	East Timor	3	149	145
11	Ethiopia	5	135	126
12	Mozambique	3	113	126
13	Togo	5	154	121
14	Rwanda	5	124	102
15	Madagascar	3	73	85
16	Uganda	4	63	126
17	Nepal	4	133	121
18	Mali	3	114	96
19	Burkina Faso	3	85	80
20	Guinea	5	144	173
21	Comoros	4	172	134
22	Tanzania	3	93	102
23	Gambia	4	112	158
24	Bangladesh	4	160	147
25	Haiti	5	147	177
	Average	4.12	134.32	131.84

The GDP per capita rankings (purchasing power parity international dollars) are computed from *World Development Indicators* (2008) data base assembled by the World Bank. The civil liberties data come from the *Freedom House* 2009 website (downloaded June 2009), economic freedom rankings from the Heritage Fund's *2009 Index of Economic Freedom* (downloaded July 2009), and corruption rankings from the *2008*

[55] The country rankings are taken from http://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP)_per_capita.

[56] See, for example, Congleton and Lee (2009) or North, Weingast, and Wallis (2009).

Corruption Perceptions Index (downloaded from Transparency International's website July 2009).

Together, tables 5.3 and 5.4 clearly imply that poor countries tend to be authoritarian, tend to have limited political and economic civil liberties, and tend to be places where connections with (and payments to) the government matter. These are places where a government's own security risks dominate public policy. Wealthier countries, in contrast, have little corruption, broad economic and political liberty, and tend to be democratic (or ruled by democratic governments).

B. Conclusions: Governing and Rules as Risk Management

Hobbes (1651) the first political theorist to point out that life in a world without law is far riskier than life a society with many standing rules, especially ones that protect life and property. According to his theory, essentially any state that provides security for life and property is superior to anarchy and its residents would (or should) recognize it as such. This conclusion that governments are ultimately based on their successful risk management, however, does not imply that all governments do so equally well, nor does it directly provide a rationale for why governments might be inclined to provide such services.

This chapter suggests that governments tend to adopt civil and criminal laws because they are productive, because the encourage economic development and tend to attract residents to their community, rather than induce current residents to depart. It is largely for this reason that many parts of civil and criminal law are older than the governments that enforce them. These risk reducing rules, unlike many others, tend to benefit nearly everyone in the communities that have them.

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Indeed, even thieves and murderers can be said to benefit from such rules. Although they face risks from official sanctions, they face smaller risks from their fellow citizens and team members, because of such laws.

However, not all governments have the same incentives to address risks or to provide other services. A good deal of criminal and civil law is similar across societies, but many other laws, regulations, and procedures vary by regime type, technological setting, region, and legal history. This is at least partly because the risks of interest to rulers vary with their current circumstances and how they understand them, the latter largely being a consequence of local history.

The present book does not provide an explanation for the regime types in place. For such analyzes, one can consult Congleton (2011), North, Weingast, and Wallis (2009) or Asemoglu and Robinson (2005). It is sufficient for the purposes of this book to point out that the types of risks that capture the attention and resources of government varies with governmental types. As a consequence, as the type of government changes, the types of risks addressed through public policies also tends to change. This, as developed further in chapter xx, helps explain why policies with respect to risk change substantially during the late nineteenth century Europe. That technological developments also affect the both types of risks faced and the techniques available for managing them helps to account for much of the shift in governmental risk-management services provided during both the late nineteenth century and also during the twentieth century within liberal democracies.

Of greater interest than the form of government for the purposes of this book is the type of rules that tend to be adopted.

This books, follows Hobbes, in suggesting that the management of both natural and social risks is a primary explanation for the governments and for the rules that are adopted. This chapter suggests that such responsibilities have been present from the earliest governments that we have documentary evidence from and continues to the present time. The particular risk-managing services change through time, but many of the core rules have been amazingly stable through time, as with the fundamentals of tort and criminal law.

It bears noting that the rules adopted, like those in families, tend to be fine grained and rather detailed. This is not as true of legal principles, which allow one to understand the basic rationale of a legal system, then of the judicial and legislative decisions that deal with specific cases. Some rules simply outlaw behavior that is known to generate risks. One cannot simply take a gun and use it to shoot out one's neighbor's windows, regardless of whether the neighbor is in any immediate danger or not from such target practicing and regardless of how much it improves one's marksmanship. Nor can one simply take one's neighbor's property and use it for oneself, regardless of whether your use is of greater value that that of the neighbor. The risks associated with allowing such behavior are more or less obvious, and are discouraged through a variety of penalties.

"Treasonous activities" in an authoritarian regimes, may threaten only the rulers, but of course it is the rulers who make the rules and will do so to limit there risks unless there are obvious advantages for not doing so.

Although the rules and other risk managing methods of interest in Part II are those developed by governments, it bears noting that a wide range of similar rules are used by most organizations. Who use rules to reduce risks for the organization themselves and for their employee-team members.

The chapter suggests that the emergence of stationary communities at the time of the agricultural revolution in 10,000 bc is likely to have been associated with their ability to manage a variety of risks. First, through relatively more stable food supplies they helped reduce existential risks for their residents. Second, it is likely that they adopted a series of what we now call criminal and civil laws to moderate risks posed by their residents to one another. And in cases in which an "elite" served as rule makers, the early governments doubtless made it a crime to threaten the elite. Note that the Code of Hammurabi punished crimes against the state and church far more severely than crimes against freeman.

In modern democracies, the risk that attract the interests of those with the authority to make rules tend to be those confronted by ordinary voters rather than political elites, although the latter are not entirely neglected. To be elected to higher office, voters must anticipate better services--usually better risk management services--from their preferred candidates than from their rivals.

It may be said that the communities with the best set of rules for avoiding existential list prove to be the most robust and durable. It may also be said that the most robust and durable legal codes will tend to be the most copied by successive governments. The best rules limit a wide variety of risks and so tend to produce stable (predictable and relatively safe) and prosperous communities. Communities with the worst rules will tend to be frail, poor, and short-lived as Hobbesian anarchy reestablishes itself.

If governance is about ruling, much of the productivity of government arises from its ability to adopt and enforce rules that reduce risks and thereby increase a society's viability.

When losses from surprise events exhaust both private insurance, private rainy day funds, and lines of credit, the affected groups will attempt to secure additional resources through other means. For example they may form new private organization, new public organizations, or lobby government decision makers for loans at below market interest rates or for direct payments or services, which limit the losses for the crisis at hand, as developed in parts II and III of this volume.

This happens frequently enough, that most governments have a variety of standing programs for providing such "supplemental" crisis insurance. In most democracies, the central government provides flood insurance, unemployment insurance, and insures bank deposits (from runs and poor management) using earmarked fees and taxes. Such standing programs often resemble ordinary insurance programs insofar as they are funded before the emergencies arise. They differ in that during unusually unfortunate times the coverage is normally extended beyond those pre-funded reserves.

Chapter 7: Democracy and Social Insurance

> The commitments we make to each other: through Medicare, and Medicaid, and Social Security, these things do not sap our initiative; they strengthen us. They do not make us a nation of takers; they free us to take the risks that make this country great. (B. H. Obama, inauguration speech 2013)

The previous chapter suggests that governments are not principally concerned with externality and public goods problems, but rather with risk management, only a subset of which fall readily into those categories. It is not that risks and uncertainties are never caused by externality or public goods problems, but that rulers and/or voters are not often motivated by such problems, per se, but rather attempt to use the capacities of government to eliminate, curtail, or ameliorate a wide range of risks that are not easily managed by smaller private organizations or individuals. There are economies of scale in the enforcement of risk reducing rules and also in risk pooling, the latter of which is the focus of this chapter.

That there are differences in the risks and uncertainties confronted by democratic and authoritarian governments have implications for shifts and policies that tend to occur during transitions from authoritarian to democratic governments, and vice versa. Dictators have strong interests to adopt rules that extend their time in office, which in turn tends to promote their own survival and prosperity. Democratic governments also attempt to prolong their time in office, but are constrained to win regular elections to do so. As a consequence, the rules adopted in democracies tend to advance voter interests, particularly those of moderate voters. In this, it can be said that differences in particular rules and enforcement methods are indirect consequences of risks generated by their respective constitutional environments.

The previous chapter suggests that law itself is substantially a risk-management service provided by governments. It is not inherently a pure public good insofar as it can be and often has been less than uniform in its treatment of individuals and groups, and also enforced in less than a uniform manner. This is not to say that most persons in a society do not benefit from greater certainty, is it only to remind the reader that this statement is not the same as saying that "the law" is a public good in the technical sense used by economists. The end product of "the law" tends to broadly, if somewhat idiosyncratically, reduce both risks and uncertainties and this makes most persons--rulers included--better off.

That rules advance the objectives of those with the authority to make and enforce them is, of course, why laws are adopted and enforced by governments, organizations, and families. Rules, nonetheless, often advance the ends of individual and groups by solving coordination problems and social dilemmas, which improves average outcomes for those in situations that produce such problems.

If the world were simple enough rules could assure risk free outcomes that maximize average outcomes. Such simplicity is present in the illustrations used in this book and in essentially all economic textbooks (and most research papers).

However, an illustration is not the world. The problems confronted in real life are not entirely static or entirely predictable even in settings where many risk-reducing rules are in place. Unpleasant surprises, thus, occur both because of unanticipated natural events (storms, illness, human error, etc.) and because of unanticipated interactions among the rules themselves. Unpleasant surprises may also occur in cases in which uncertainty as considered to be productive and so is assured rather than reduced by the rules in place.

Because of natural and social uncertainties, unpleasant surprises continue to occur even in the best ruled of states.

When risks are confronted in spite of the best rules one can imagine, coping with, rather than avoiding them becomes the only possible strategy for reducing losses. With this in mind individuals purchase insurance (or self ensure) and adopt other routines for recognizing and adjusting to surprises as they occur. The question addressed in this chapter is the extent to which governmental policies may play role in assisting individuals to cope with risks that remain after all useful rules for curtailing risks have been adopted.

With respect to insurance, there are several steps that a government can take that individuals and private organizations can take because of their greater ability to impose binding rules and because of their ability to tax.

A. Rules to Improve Private Insurance Markets

To shed light on the role that public policy may play in insurance markets, consider first the role that government may play in individual decisions to join income security clubs or to purchase income insurance. First, there is, as described above, the government's role in characterizing and enforcing civil law. Contracts are not entirely a product of formal state laws, but clearly such laws reduce uncertainty about whether a formal insurance relationship will be carried out or not. In contrast, bankruptcy laws tend to reduce risks for insurance entrepreneurs while increasing them for their investors and member-customers. A bankrupt firm is freed from most of its contractual obligations, and apart from cases of fraud, the penalties for bankruptcy consists largely of reputational effects for the persons defaulting on their obligations.

Given this civil law framework, both reliable and unreliable income security clubs and insurance companies may coexist in the same markets for significant periods of times. To see how this affects the risk-limiting properties of private insurance, consider a setting in which there are three outcomes, a normal good outcome, a moderately bad outcome, and a disastrous loss. Three outcomes are sufficient to illustrate many of the key reasons why individuals purchase insurance. They could be, for example, outcomes associate with fluctuations in weather, health, asset market, and/or accidents. As in most insurance settings, assume that the probabilities and losses are known to everyone.