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Who Gets What, When, How? Power, Organization, Markets, Money and the Allocation of Resources

Martin Shubik

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WHO GETS WHAT, WHEN, HOW?
POWER, ORGANIZATION, MARKETS, MONEY
AND THE ALLOCATION OF RESOURCES

By

Martin Shubik

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WHO GETS WHAT, WHEN, HOW?
Power, Organization, Markets, Money and the Allocation of Resources

Martin Shubik

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Preface

Money is a mystery and financial institutions are often regarded as guardians and promoters of the mystery. These sketches are designed to help an individual interested in, but not technically trained in economics, understand markets, money, credit and the evolution of a mass market

system embedded in the rich context of its political environment and society.

The efficient functioning of a dynamic economy requires the presence of money and financial institutions. The great variety of financial institutions in any advanced economy requires that a synthetic approach is used to understand what the whole looks like. Verbal description provides an overarching view of the mixture of history, law, philosophy, social mores, and political structure that supplies the context for the functioning of the economy. This has been vividly illustrated by Adam Smith, his teacher the Reverend Francis Hutcheson and his close friend David Hume.

There are two different but highly allied themes in this single slim volume. Chapters 1, 2, and 3 supply the rich context of history, society, polity and law in which every economy is embedded. Chapters 12 and 13 sketch what might lie ahead given the current state of the world. These chapters require no symbols or technical depth. In contrast Chapters 4 to 11 offers a reasonably nontechnical exposition of some of the considerable development in formal economic theory pertaining to money and financial institutions as economics struggles towards emerging as a science, balancing quantitative measures with qualifications that help to explain what the numbers mean.

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Acknowledgments

I am indebted to many colleagues over a span of 65 years. I thank all, but rather than add a small address book. I let them be mercifully anonymous so that they can avoid all blame for the contents.

Chapter 1

The Emergence of Civilization with Money and Financial Institutions

Presented here is the sketch of a basis for understanding economic dynamics and the means for social, legal and political guidance of an economy. It can be shown that markets and money are emergent phenomena. They will come into existence regardless of the political structure. However not all goods and services are amenable to distribution by markets. Many public goods and bads exist and a society must devise methods to deal with them. Markets depend on measurement. It is relatively easy to quantify apples for the market; but even there the listing of the number of types, the freshness, the size and quality of the apples pose problems in specifying weights and measures. In contrast the measures of many varieties of pollution such as smog, or noise are far harder to quantify. Even harder and closer to the domain of basic philosophical dispute are items such as the modern versions of Blood Money or payments made to compensate for injury or death.

At least since the British utilitarian philosopher Jeremy Bentham there has been an emphasis in economics to introduce the measurement of pleasure and pain. The virtues of measurement have been seen in every science; but it is important to consider that measurement may easily be prematurely imposed on phenomena that are not, given our current state of knowledge, susceptible to the precise quantification required. Many of us in the United States become poll junkies. We have to be fed our daily numbers, be they the poll-of-polls showing Politician A is ahead by 6% over Politician B; or according to the latest World Great Restaurant Poll the world's greatest restaurant is a little known gem in Bariloche; furthermore recent popular residence polls show that taking all factors into account the best city in the United States for year round living is Terre Haut, Indiana, leading the runner up, Fresno, California, by 23.52%. In a sober mood most of us know that many of these numbers are salesman hype combined with specious accuracy to give them extra authority. We know that popular saviors lie and that hucksters exaggerate; but in getting our daily fix we want to know what the numbers are, not how they were generated and what this means. It is quicker, easier and more fun to supply our beliefs as to what they mean rather than bore ourselves by reading footnotes, or even worse, having to look up documents with technical descriptions. Life is too short to do so.

In the United States economy there has been a tendency to try to monetize virtually everything. Oscar Wilde aptly described one of his characters as "a man who knows the price of everything and the value of nothing." This quip distinguishes between the process of valuation and the outcome of many valuations which may form price. As a good approximation, in every-day life the prices formed in a market for eggs or canned beans do a pretty good job in connecting price and valuation. In evaluating worth of health, cultural heritage, criminal justice, defense, the citizens' army and many other features of life in a complex society, market price may not exist.

The stress in these sketches falls heavily on those parts of the economy where, measurement,

market and money all play a critical role. These parts are large enough and sufficiently important to merit understanding as a separate topic from other means to distribute resources; but this must be done with appreciation of the broader context of the society and a feeling for both the qualitative and quantitative aspects of resource allocation.

As my aim is to provide an overview moving between the qualitative and the quantitative I provide, on occasion, crude figures or "guesstimates" to sweeten the intuition, as well as direct figures from specified sources. Accuracy is a function of purpose. The precision called for in trying to indicate that there has been a rise in crime in Chicago differs from the precision needed to land a machine on Mars. The approach adopted here calls for getting a rough feeling for some magnitudes that are virtually impossible to obtain quantitatively without a lifetime of statistical and econometric research. Carefully defined data on items such as the world revenue from bribery and extortion do not exist beyond estimates based on a shaky classification.

One way in which measurement emerges in a society is that a popular writer, a politician or a special issue partisan promotes and publishes a "guesstimae" based on little more than assertion; this is denied by opponents who cook up guesstimates going in the other direction. If battle is joined partisans call for pundits, pollsters, lawyers, social scientists and other experts and new measures emerge.

A goal is to make this book as non-technical as possible consistent with avoiding the dangers of oversimplification of complicated phenomena. In order to do so an understanding of some of the basic concepts of game theory and gaming are helpful. These are presented along with some notes on measurement in appendices.

For those who like previews I have presented a preliminary sketch of all following chapters, but for those who prefer to go to the first course without studying the full menu an immediate skip to Chapter 2, should work.

Chapter 2 on Ownership and the Allocation of Wealth is an essay unto itself sketching the emergence of a complex human society from the very beginnings. It deals with the basic problem of all life, the acquisition of all resources by every means. The title of this book is a paraphrasing of the distinguished Political Scientist Harold Lasswell's definition of politics as "Politics is the study of who gets what, when, how." But it is suggested here that this applies to a far larger stage than politics alone. Politics is only one of the many ways in which resources are transferred.

In Chapter 3 entitled Custom, Law, Markets, and Measurement the scope is narrowed considerably, dealing more explicitly with resource allocation by politics, law and economics. In spite of the national (and historical) pastime of telling lawyer jokes, the enormous role of lawyers and the courts in helping to clarify vague categories and provide sufficient measurement in problems where measurement appears to be impossible is considered. Good law is pragmatic and empirical.

Chapter 4 called A Preliminary to Understanding Markets and Competition turns towards understanding more precisely the conditions needed for markets to function. A primer is given

that explains what game theory is about, why it is important in many aspects of the economy, what are its great strengths and its considerable weaknesses in understanding human affairs. This includes how and why politicians, news commentators and the public use gamesmanship and misuse game theory lingo such as `zero-sum, strategy, win or win-win' to sound scientific and authoritative when there is little basis for their statements.

Chapter 5 on Money, Markets and Minimal Financial Institutions lays out the logic as to why the economy needs money and why money comes in several different tasty flavors blending a peculiar mixture of different basic immutable economic functions with accommodation to possibly ephemeral particular social and political facts. This leads us through commodity money, gold, silver or barley (and more); fiat money; commercial bank money, accounting money and special monies.

Chapter 6 titled Process and Institutional Economics lays stress on time, expectations and durable assets. It considers the role of fiat money as an asset and discusses debt. Government money is involved in the creation and destruction of debt any understanding of the workings of a modern economy requires that this relationship be made explicit. There are many different institutional ways fiat and debt may enter and depart from the economy. The smoke screen created by all political participants covering the ways in which essentially worthless paper or symbols of government money and debt instruments are created in the public economy is a work of art. Any fledgling international banker knows how to replace a dirty word such as bankruptcy by a euphemism on the reorganization of debt and the benefits of refinancing.

Chapter 7 is named Time and Institutions. The critical observation here is that as soon as time and process are recognized explicitly, so must be the carriers of process, or the **rules of the game** that specify the limits on the game. It becomes necessary to introduce government, even if only as a referee who stands ready to judge if the rules have been followed by the players and is able to act appropriately if they have been violated. The game analogy is reasonable. After many years even the rules of Baseball or Cricket may be modified, often to reflect new technology and public opinion.

The large doctrinal battle in Economics and Political Science is fundamentally on how much power government should have in the society. This is best understood by considering the polity and economy in a society as having their roles described as games within the game where the social and political structure change on longer time scale than that of a single administration and much economic life.

Chapter 8 deals with the presence of risk and uncertainty. Beyond the ongoing debate on the distinction between measurable risk and uncertainty, there is a distinction between outside or exogenous risk and strategically created or endogenous risk. It is important to note that it has only been in the last 300 years that the anatomy of risk has been studied formally and applied to many highly practical problems all over society. The economic applications of the study of risk have been broken down into many special subfields such as fire, health, life and property insurance and the explosive growth of futures contracts and hedging instruments. There is also a large and important literature on gambling, fortune telling and wishful thinking. A puzzle in the

history of the development of economics is why a formal theory of probability appears to have not developed in China in spite of an apparent propensity to gamble.

Chapter 9 deals with innovation and ecology. It is here that we must face a competition that is different from the pure theory ideal that provides much of the popular justification for a competitive price system as supported by individuals such as Alica Rosenbaum (the maiden name of the more charismatic Ayn Rand), or institutions such as the Cato Institute. What emerges is a price system with few enormous international firms (in Econospeak Oligopolistic) producing or buying innovation; with the system adjusted for risk and accompanied with a sophisticated financial and legal system that makes this adjustment possible. This is a far cry from the simpler worlds of Milton Friedman, Friedrich Hayek and others.

Chapter 10 is entitled Alice in Wonderland and Mathematical Institutional Economics. It notes that there is a close connection between the physical economy and finance. Ideally there can be ownership certificates for all physical items and much of trade involves exchanging claims to ownership rather than the physical objects. When the full institutional reality dealing with exchange in turbulent times involving political, technological and social change is considered the "economic game" involved looks more like the croquet game played in Alice in Wonderland that it does to a formal game with well-defined rules.

Chapter 11 is devoted to considering the possibilities and limitations in having economics emerge as a hard science. This is not a yes, no proposition. The formal economic basis showing how to treat fundamental concepts such as fairness, justice, symmetry and initial ownership claims must be linked to their philosophical basis. Furthermore, formal mathematical models can and must be constructed that permit both experimental games and serve as the underpinnings for use in applied economics. A discourse on liberty, fairness and efficiency does not immediately put bread on the table; but any successful society has to take these concepts into account if it is to thrive.

Chapter 12 contains concluding commentary combined with thoughts on migration, the closing of all of the physical frontiers on Earth, and the relationship between innovation and war. Much of this chapter is speculative and as much as is possible I try to sort out what I regard as reasonably scientific observations by a professional economist, from commentary involving inductions based more on my sociopolitical beliefs.

The book ends at Chapter 12; but Chapter 13 is a somewhat gloomy addendum to Chapter 12 with a few observations that if we do not take actions on the items noted we run major risks of a dystopian world at best. I end with some Science Fiction recommendations based on observations through my murky crystal ball.

As political economy has developed, words have not been enough to bring clarity and precision to many aspects of economic activity. Mathematics and formal logic have served well in the new development. Like all tools they have their limitations. In spite of the desires of many economic theorists and econometricians to quantify and provide formal models there is no magic set of equations of motion that fit all economies. The analogy that one might make with the laws of

physics does not hold easily. There are many individual business and government economic problems that call for deep analytical treatment; but each requires considerable hand tailoring in application to specific problems. Two well-worn Latin phrases, though not as much in use as they were a hundred years ago still signal the basic truths in applying mathematical models to predict human behavior. They are *ad hoc* and *ceteris paribus.* The first is still in common usage and means that an action or item referred to as *ad hoc* is designed for a specific purpose. The second phrase, *ceteris paribus,* translates as "all other things being equal." It was used extensively by the important English economist Alfred Marshall to indicate that in the situations he examined he was ruling out immediate changes in, or feedbacks from the environment. This term is useful, more striking, and shorter than all other things being equal, and deserves being revived.

In these sketches an overall synthesis is given of the many aspects of a politico-economic and social system where many decisions are made on different time scales and the resultant dynamics is loosely coupled and often badly coordinated.

Chapter 2

Ownership and the Allocation of Wealth

> How is wealth distributed?
>
> The good old rule sufficeth them, the simple plan. That they should take, who have the power, and they should keep who can.
>
> — William Wordsworth, *Rob Roy's Grave*

Economics is concerned with the ownership, production and exchange of limited resources. It is primarily associated with physical items such as land, houses, factories, food and many other individually appropriable items. Frequently it is associated with wealth and the many synonyms of wealth include: assets, fortune, means, and capital, riches where the items are either individually owned physical goods or financial assets. Left out of most definitions of wealth are the less tangible aspects of human wellbeing such as health, *joie-de-vivre*, enjoyment of and respect in the society in which one lives. Two other off the balance sheet assets include the belief and actuality that the legal system and the various institutional bureaucracies are reasonably honest and equitable in treatment of all citizens. Political power is usually not evaluated in terms of a numerical measure of power.

Economic and political theorists, in contrast with their legal brethren tend to want to look for universal properties in the systems they study. Yet the connection between theory and application must be made if the theory is to bear fruit. The words of the perceptive political scientist Robert Dahl (1961) are of relevance here. He noted (p. 317): "Moreover propositions stated in universal terms are rarely assumed by men of common sense to imply universality in practice: to the frequent dismay of logicians, a common tendency of mankind — and not the least of Americans is to qualify universals in application while leaving then intact in rhetoric."

As is noted below this is not merely a pandering to men of common sense but is at the basis of the relationship between theory and practice.

Before we narrow down our considerations to those goods and services that can be handled directly, or with some modifications by markets and a price system the full context of the allocation of goods and welfare is considered.

A basic phenomenon such as the individual ownership of many types of goods and services is not God-given. It is part of an ongoing evolution of the rules of the game or the laws of current society. More properly coevolution must be considered. The feedbacks between the growth of trade and nature of the laws governing ownership and exchange flow in both directions.

The transfer of resources between humans appears to have existed since the appearance of humans, and the number of ways by which this transfer can take place are relatively few. New methods have been added over the years, but the old ones still exist. As with any taxonomy there is room for argument in the definitions, and from some points of view different categories may overlap.

In the list below, fifteen different mechanisms are noted that may be used to transfer resources. Each of them may be disaggregated into a set of more refined mechanisms. Nevertheless, the list in this crude form is suggestive of the different approaches used in all societies for resource allocation. Although we do not have good estimates of the relative importance of these different methods for distribution within our own society, we attempt to offer some crude estimates. They are critical in order to set the context for understanding the relationship between politico-economic and socioeconomic allocations in contrast with the market.

The following fifteen processes[1] cover the major means for the allocation of resources. They are presented more or less in the order in which they appear to have been first utilized:

1) Biological and ecological processes;
2) Allocation by chance;
3) Hunting and gathering or foraging;
4) Allocation by non-legitimized force;
5) Allocation by higher authority, autocracy;
6) Allocation by fraud, deceit and other illegal activity;
7) Allocation by custom, including gifts and inheritance;
8) Allocation by war;
9) Allocation by the legal system;
10) Trade with bargaining and persuasion;
11) Allocation by bidding at auction;
12) Allocation by voting;
13) The double auction;
14) The mass economic market with a price system; and
15) Oligopolistic markets with product differentiation and innovation.

Some comments on each method are noted: **The biological processes** of birth and disease are incidents of considerable resource transfer that are easily overlooked in economic accounting. In the study of overlapping generations much has been made of the possibility of inheritance but little note has been made of the inputs and the energy costs of the mother's birth process and other mammalian transfers such as breast feeding and initial mothering. In a modern economy many functions of mothering can be monetized including wet nurses, baby nurses and kindergartens. Furthermore, especially in comparing costs and benefits of reproduction, family structure and child rearing there are many open questions concerning the form and use of economic valuation.

The biological and ecological process aspects of disease also pose problems in sorting out the nature of resource transfers that are involuntary or voluntary in varying degrees. These methods of transfer have been present well before *Homo sapiens.*

Allocation by chance: There is hardly any aspect of human existence where chance does not enter. The human as a rationalizing animal is often quick to attribute personal skill rather than luck to favorable outcomes, as is abundantly illustrated in the *ex post* discussion of successful stock market investments.

Plain dumb luck plays its role in nurturing hope. Some few people actually win lotteries. Others encounter other types of windfall. Still others may have the dice go against them. Fortune frowns and everything goes wrong. The perceptive and prepared individual will recognize and exploit good fortune better than others; however, she still needs some good fortune to prosper.

Hunting and gathering or Foraging: From the emergence of the various species of *Homo* until around 12,000 BC when farming started to replace hunting and gathering, foraging provided the major resource inputs through the Paleolithic, Mesolithic, and Neolithic ages (Britannica, 2015). There is little hard evidence of output or trade until historical times, but the stream of pre-historical innovations indicates many differentiations in function and set the stage for increasing volumes of trade and production (Diamond 2002).

The archeological evidence of the important precursors of civilization appear.

Tools: It is estimated that clothes were first used around 170,000 years ago (Toups, 2010); wooden spears around 400,000–500,00 years ago, followed by spears with stone heads around 300,000–250,000 years ago (Wilkins–Schoville–Brown, 2014). The control of fire appears to predate *Homo sapiens* with no hard dates, as does the first cooking (Berna et al., 2012; Organ et al., 2011). Pottery cooking vessels appear in China around 20,000 years ago (Wu, 2012). Around 3,200 BC writing was invented in Sumer and this may be regarded as the start of historical times where the population could leave its own verbal records (Taylor, 2013).

Art: The earliest example found of symbolic art is in South Africa from Blombos cave-350. It is dated around 70,000 years ago (Henshilwood, d'Errico and Watts, 2009); cave paintings in Spain date to 40,000 years ago (Pike, 2012), and the Venus of Hohle Fels, dated around 35,000 years ago is the earliest known figurative statue of a woman (Conrad, 2009).

Domestication of animals: Evidence on the domestication of dogs dates 33,000 years ago (Thalmann, 2013); pigs, 10,500; sheep, 11,000; and cattle, 10,500 (Zeder, 2008).

Human settlements: The coming of agriculture completely changed the potential for population density. The appearance of permanent settlements or villages is evinced by the Neolithic village at Catal Huyuk in Anatolia somewhere between 7,400 BC to around 10,000 BC (UNESCO), 2015 and Jericho in 9,000 BC (Encyclopedia Britannica, 2015).

There is no clean, clear universal definition of what constitutes a village, town or city, for all purposes. Legal definitions are administratively useful in a modern society. The many dimensions of their functions are not caught by any single definition. For our purposes here, roughly the distinctions are density, size and differentiation in the occupations of the inhabitants. The key factor in the growth of economic exchange and an organized rule is division of labor.

Allocation by non-legitimized force.

> The mountain sheep are sweeter,
> But the valley sheep are fatter;
> We therefore deem'd it meter

To carry off the latter.
We made an expedition;
We met an host and quell'd it;
We forced a strong position
And kill'd the men who held it.
— Thomas Love Peacock (1785–1866), *The War-Song of Dinas Vawr*

At the tribal stage of civilization, it is difficult to differentiate between legitimate and illegitimate force as there were no formal laws to be broken. Long term relations among nomads are considerably less than among sedentary residents, yet even with nomads the reputation of an individual such as a spear-maker may make it more desirable to trade with him rather than kill or enslave him.

As the body of law increases in the city state, the empire or the nation state, and a body of international law grows, the distinction between the applications of legitimate or illegitimate force grows.

In spite of the growth of international law in the modern economy the drug trade and protection rackets probably account for at least 1% and no more than 5% of world trade, but they are notoriously difficult to evaluate closely (UNODC, 2012).

Allocation by higher authority, autocracy: The first empire was formed about 2250 BC, by Sargon the Great, in Mesopotamia (Schrapkamp, 2013; Postgate, 1994). It was succeeded the world over by many empires all, in some form or the other with five broad categories of inhabitant: The aristocracy, the religious establishment, the warriors or army, the merchants and craftsmen and the laborers or peasantry. Modern versions of authoritarian rule have included dictatorships and theocratic structures in many forms. They all bear the feature that considerable allocation of physical resources and the division of power is by the dictates of the rulers.

Allocation by fraud, deceit and other illegal activity: Force has been with the species *Homo* since its beginning, but in a hunter gatherer social structure the lack of records and the limits on communication make fraud and deceit far less effective as methods for the diversion of resources than in a complex record keeping (and forging) society. In a society such as the United States undoubtedly several billions are allocated in this manner. There are many definitional problems in the classification of fraud and crime. This is especially true in the area of "white collar crime," where the type of deceit and fraud is more gentlemanly than common theft.

Allocation by custom, including gifts and inheritance: Custom accounts for a considerable amount of allocation, especially in more traditional societies. The church may collect its tithe with or without formal rules requiring its payment. In England and in other monarchies the king is entitled to certain resources. The size of tipping in different societies is basically a custom-determined method for allocating resources. Inheritance customs are extremely influential and gifts play an important role in distribution.

At this point it is also important to note that it is not only goods and services that are distributed

in society, but also items such as honor and prestige.

A monarchy sensitive to custom and the political winds may be better in distributing the "honors list" of appropriately legitimized titles than is a direct price system or a repressive dictatorship.

Gifts, honor and prestige all pose problems far beyond those of normal economic goods. It has long been stressed by anthropologists (Mauss, 1954) and others that although the exchange relationship and the gift and honors relationship may have much in common they also are considerably different.

Even though the economist or psychiatrist would immediately say "Something must be given in return for any gift," nevertheless both will recognize that any *quid pro quo* is difficult to characterize and there is a cloudy zone between gift and bribe.

Allocation by war:

> Bent double, like old beggars under sacks,
> Knock-kneed, coughing like hags, we cursed through sludge,
> Till on the haunting flares we turned our backs
> And towards our distant rest began to trudge....
> My friend, you would not tell with such high zest
> To children ardent for some desperate glory,
> The old Lie; Dulce et Decorum est
> Pro patria mori.
>
> — Wilfred Owen (1893 – 4 Nov. 1918)

Since the start of organized society (circa 12,000 BC) war has been a common phenomenon. Prior to this time the concept of what constitutes a formal war between two or more legitimized societal groups has been difficult to define. Even now the various types of war (Shubik–Verkerke, 1989), civil war, terrorist acts, proxy wars and insurgencies are difficult to categorize and their costs and yields are extremely difficult to evaluate. Many crude ball-park estimates[2] are presented as their main purpose is to provide an appreciation of context and to raise problems in interpreting quantification in a complex environment.

The growth of population of Homo Sapiens: As a basic part of the context of war the size of population is considered Table 2.1 shows two estimates of population growth. The population began around 160,000 (200,000?) years ago and the World migration out of Africa is estimated to have been around 60,000 years ago (Stringer, 2000; McEvedy–Jones, 1978).

The Out-of-Africa hypothesis for the origins of the world population appears to be the best supported at this time and current information indicates a small population that has been guessed as low as around 10,000 left Africa around 60,000 BC.

The commencement of agriculture around 12,000 years ago involved both the domestication of many animals as well as the growing of crops. The organization of villages evolved into the city state with the functional emergence of rulers and warriors and although tribal nomads still fought

each other and plundered settlements, war emerged as a more structured sanctioned act in contrast with traditional skirmishing. As the Old Testament abundantly describes war among city states and emerging empires was often savage with cities totally destroyed and populations eradicated or enslaved. Yet even to this day there is surprisingly little literature on economic and socioeconomic values and costs of war. It would require a completely different book to even start to lay out and present an in-depth analysis of the socioeconomics of war.

As the city states grew and led to the development of empires with zones of high population density so did the opportunity rise for mass killings from war, via slaughter, disease and starvation. Table 2.2 presents a brief summary of the top seven wars in terms of estimated casualties. The wars, or associated clusters of wars were: (1) World War II, 1939–1945; (2) The Wars of the Three Kingdoms 184–280; (3) The Mongol Conquests, 1206–1368; (4) The Taiping Rebellion, 1851–1868; (5) World War I, 1914–1918; (6) The Qin, Ming wars, 1618–1683; and (7) The Conquests of Tamerlane, 1369–1405. The last column is the percentage killed of the world's population.

Table 2.1 Estimated world population of Homo sapiens

Date	Estimated Range of World Population (in millions)	
Around 160,000 BC	About zero	0
Around 60,000 BC	0.125	Fewer than 0.01
Around 10,000 BC	2	4
1 AD	170	188
500 AD	190	210
1000 AD	265	295
1500 AD	425	461
1600 AD	545	554
1700 AD	610	603
1800 AD	900	990
1900 AD	1625	1654
1950 AD	2500	2545
1960 AD	3043	3943
1970 AD	3713	3710
1980 AD	4451	4461
1990 AD	5289	5308
2000 AD	6080	6145
2010 AD	6866	6916

Sources: Harpending et al., 1993; History Database of the Global Environment; Hopkin, 2005; and McEvedy and Jones, 1978.

Table 2.2 The 7 deadliest wars

Date	Population	Deaths	War	Length	Percent
1939	2,270,000,000	58,000,000	1	6	2.6
184	190,000,000	37,000,000	2	96	19.5
1206	360,000,000	35,000,000	3	132	9.7
1851	1,219,000,000	32,000,000	4	17	2.6
1914	1,794,000,000	31,000,000	5	4	1.7
1616	545,000,000	25,000,000	6	65	4.6
1369	353,000,000	17,000,000	7	36	4.8

Sources: McEvedy and Jones, 1978; UN, 1999.

How does one evaluate the economic costs of the estimated 58 million deaths in World War II? Do we lump together deaths in the armed forces, with deaths from starvation, or torture, or in gas chambers; deaths from the atomic bomb or in fire storms in bombed cities?

Even with the considerable improvements in both theory and measurement in modern economics there are enormous socio-politico economic problems on how to carry out a meaningful economic assessment that offers useful insights as to how one weights the worth of the overthrow and replacement of governments and social structures against the costs. Along with government change we are required to evaluate the destruction of both new and outdated manufacturing plants, as well as locations that are regarded by some as sacred landmarks and by others as obstacles to development.

On top of this the economic worth of mass murders and the wartime developments in technology, science and medicine must be considered. At first glance it may appear that there is a considerable element of causality between the emergence of many major inventions directly or indirectly as the product of war, I believe this to be significant; however, as causality is so difficult to establish there are those, such as the von Mises Institute who argue otherwise (Klein, 2013).

The production of crude figures where none existed before at least provides spice for the feast of political rhetoric on topics such “the unlimited price of Democracy,” or “Freedom at any cost.” In a TV world where small wars can be converted into a spectator sport for an electorate we might expect the growth of attempts to monetize the effects of war. Stephen Daggett (2011) writing for the Congressional Research Service has provided for estimates for all major US wars. Estimates by Joseph E. Stiglitz and Linda J. Bilmes (2008) suggest more than $3 trillion for the Iraq war. This contrasts with Daggett’s estimate of $784 billion. In context of the purpose for which they are used both estimates may be legitimate.

Here the basic point to be made is that science can do little more than help to sort out the conditions for measurement. In economics much of measurement is in terms of money; but for many problems the calculation and the uses of monetary measures must be used with extreme caution and the evaluation of war is one of them. Much of everyday economic life is susceptible to the monetary measures and much of it goes on enabled by a war fought to preserve or provide

the conditions for a peaceful life.

Allocation by the legal system. The legal system, especially in its handling of contracts, torts and bankruptcy adjudicates compensation where individual behavior negatively influences the distribution of resources to other stakeholders without compensation. The grower of roses or the man burning rubber tires very often does not care what happens to the aroma that does not reach him. His neighbor does. There is no simple market process to cover all public goods. Bankruptcy laws are one type of public good. The optimal utilization of national parks or museums is not easily handled by a simple market. The law and its enforcement provide the ad hoc distribution rules for many public goods. The rule making is part of the process of governance; but the process of distribution lies within the abilities of the law to interpret and deal with the specifics. This ability is supplemented considerably by the economic evaluation of how one should pay for these items.

Trade with bargaining and negotiation. Trade originated with human communication in prehistoric times. Little hard knowledge is known of mechanisms and rules concerning the exchange of goods and services. Evidence suggests that the history of long-distance commerce dates from circa 18,000 years ago (Stearns–Langer, 2001). Whatever evidence there is consists of items such as obsidian or cloves or gold turning up in locales at large distances from their possible points of origin. It is reasonably safe to conjecture that first trade was probably between family members, then the extended family of around 20 or less, and then possibly within a nomadic band around 20–50.

Trade between groups might have incurred language difficulties and territorial problems determining whether two groups who encountered each other exchanged rather than fought for each other's property. The first exchanges would not be between traders but nonprofessional exchangers. Some form of trader probably emerged after exchanges had taken place several times. This differentiation in occupation could have been accelerated with the emergence of tribal grouping with hundreds, if not thousands of affiliated individuals.

There are few hard facts until evidence in Babylon (Hallo, Kasten and Shubik, 2005) of professional traders leading trading expeditions to the Far East. Thus we know next to nothing about explicit process.

Bargaining and negotiation today are used as a means of allocation in both the political and economic arenas. Important uses include the settling of labor management disputes domestically and at the international level tariff negotiations, trade treaties and disarmament conferences.

Large-scale bargaining is often carried on with intermediaries, lawyers and experts, as much of the process is devoted to reformulating and clarifying issues; as well as specifying the positions of the participants. The process itself is both costly and lengthy; but as a valuable by-product it sets the conditions for measurement in domains where measurement had hardly existed.

There is a considerable difference between bilateral bargaining and multi-person bargaining. It is fairly well established that two-party bargaining in spite of its costliness appears to be a useful

and viable form for the settlement of a broad range of problems.[3] It is not clearly understood how the effectiveness of bargaining as a process drops off as the number of parties is increased. There is a qualitative difference at three, and possibly formal bargaining becomes unwieldy for more than three except in long term situations with four or more parties who set up a formal institution such as a trade association, or international agency where coalitions form and bargain over limited issues of common concern such as international trade or drug control.

An important feature in bargaining is that in many areas formal institutions and procedures exist to take care of the process.

There is also informal bargaining. This more properly belongs with haggling that has more of a historical and anthropological interest than an important influence on a large modern economy. In many South American, African, and Asian countries there are still relatively simple markets where one can haggle over how many chickens a pig is worth. The exchange may even be implemented by barter. There are many individuals who derive considerable joy from bargaining, buying wholesale and obtaining discounts. There are those who devote much time and psychic energy to the uneconomic pursuit of discounts and bargains. The process is only uneconomic if we fail to realize that bargain hunting is to some more of a sport than baseball is to others. In the United States and parts of Europe flea markets are sport stadiums.

The haggling in an oriental bazaar or in a horse-trading market might be regarded as the preliminary steps towards the formation of a price system.

Allocation by bidding at auction. The earliest auction noted in history is the auction for brides noted in Herodotus who assigns it a date in Babylon well before his time (Herodotus, 1992). The accuracy of both the story and the dating is highly dubious, possibly fictitious, but the story of utilizing the proceeds paid for by bidding for the most attractive of the potential brides first and using the proceeds to pay for the dowries of the less attractive encompasses not only the history of auctions but some interesting welfare economics. The means of payment is suggested as money, but coinage had not yet been invented, hence payment might have been in barley or silver by weight.

A verified use of auctions is in Roman times where *auctio sub hasta,* or auction under the spear was an immediate auction of the spoils of conquest utilized by the Romans to help to pay the troops promptly (Matthaeus, 1652). The auctioning of ships in auction by inch of candle, in England is covered in Pepys' diaries (Wheatley 1893). Surprisingly there is no evidence of auctions having been used in China prior to 700 AD (Yang, 1950).

The open auction appears to have preceded the sealed bid, and is used today for art and antique markets; as well as furs, rare wines, used cars, and tobacco. The Dutch auction, where the price is set high on a clock and gradually ticks down until stopped by the purchaser is still employed for selling tulip bulbs.[4]

In recent years a considerable amount of mathematical and operations research work has been devoted to the study of bidding. This has been motivated to a great extent by the economic

importance of bidding for contracts for the construction of large-scale systems. There is every indication that their importance will grow.

There are major differences in emphasis between the consumer price market mechanisms and the industrial and financial bidding processes. Implicit in the first is the assumption that all purchasers are small and individually powerless to influence an existing price. In contrast, professionals are more capable of evaluating the worth of even complex transactions.

Bidding lays stress upon the importance of evaluation in the actual economic process. In some instances, bidding procedures may become so complex and the items to be bid on may be so large that a two-stage bidding process is called for where the first bid is for a contract to prepare a study of the evaluation of the program for which the second bid will be submitted.

Voting.

> A man that would expect to train lobsters to fly in a year is called a lunatic; but a man that thinks men can be turned into angels by an election is a reformer and remains at large.
>
> — Mr. Dooley on reform, by Finley Peter Dunne

Voting has been both sociopolitical and economic. Both uses involve delegation of power to trustees, politicians and directors who supervise the utilization of the physical resources and money owned by others.

Voting for the election of a chief or ruler goes back at least to the Greeks in the 6th century BC (Cartledge, 1999). From the economic point of view, a critical application of voting is in imposing power over the purse. The Magna Carta aimed at the protection of the individual rights of the barons may also be interpreted as an early start in distinguishing the powers of taxation and the control of the budget of the monarch from resources owned by the aristocracy and the people. In England this process was more or less completed in 1694 in the reign of William III, creating a national debt completely separate from the debts of the sovereign. This also involved the founding of the Bank of England (Claydon, 2002).

In the United States the critical power of the purse is lodged in the House in Congress.

Voting is usually related to the control of a jointly owned resource where the actual operation of the resource is governed by a group of trustees acting as fiduciaries for the original owners. Thus, for example, corporations sell shares and the stockholders are the owners, yet the top executives with guidance from directors are responsible for the running of the corporation even though the stockholders are called upon to vote on occasion. In a similar manner, one may argue that the citizens of the United States use their vote in order to appoint trustees or fiduciaries for the running of their political system that distributes many easy and difficult to evaluate public goods.

Votes on bond issues, taxation schemes, subsidies, and grants are all examples of the political mechanism being used as a method for defining effective demand for joint goods or services,

such as roads, bridges and dams. The political voting mechanism is far more closely related to the formation of societal values than is the market system. No country really uses its price system alone to determine attitudes towards justice, public health, foreign aid, science, or education. Speaking loosely, we might characterize the market system as dealing with the effective demand for individual direct needs and desires, whereas voting systems deal with the aggregation and the creation of effective demand to satisfy societal values. The price of beans, baby bonnets, and basketballs may be determined by the market without needing to become involved in deep political problems. This is not the case for moon shots, urban development justice, enforcement, education, weights and measures or decisions on national communications systems and many other societal goods such transportation and weapons production and sale. With good *ad hoc* contract and market design one can utilize private enterprise to provide almost all of the services and goods noted; but it is an elected government acting as fiduciary for its voters that must supply some imputed public demand.

The double auction. When we search for the origins of the double auction mechanism it appears that it was preceded by the existence and growth of trade in the stock markets and commodity markets that did not emerge until the 17th century with the Amsterdam stock exchange moving into the specially constructed building for trading in 1611. The building of the Amsterdam Exchange can be reasonably accurately dated, but the growth of trade is more or less organic and explicit dating is lost in the social growth process. The Bourse in Antwerp founded in 1531 may be regarded as an earlier precursor of stock markets. It did not deal in stocks but in debt.

The New York exchange traces its history to when on May 17, 1792, twenty-four brokers signed an agreement on Wall Street under a buttonwood tree.

When the exchanges opened they did not utilize the double auction as we know it. The New York Stock Exchange utilized a sequential calling out of bids and offers. This call market sufficed with low volume trading. By 1871 the volume was too large to be handled in this manner and a continuous market with specialists replaced it. December 15, 1886 was the first day with volume above a million shares and October 28, 1997 the first day above a billion shares.

Many modifications have been made to the detailed rules for the double auction in an evolutionary adjustment to growth in volume and changes in technology, modified by politics, custom and law. The double-auction mechanism still has a major role in the mass financial markets of the world.

The mass anonymous market with a price system. The market mechanism of the impersonal price system, where each individual buys and sells at prices set by a faceless market, works well in the stock and commodity markets and appears to be well suited for solving many of the technical and administrative problems for the decentralized and efficient allocation of resources. This is especially true for satisfying the individual wants of consumers for goods and services which also can be produced and sold by relatively small individual firms.

Even if there are potentially many suppliers and customers, special considerations may cause a society to prevent an open economic market with a price system from developing. Thus the opium and other drug trades potentially could and did function as a price-guided markets but are restricted from doing so.

The price system may be regarded as a limiting case of multilateral bargaining[5] when the participants are very many, the commodities standardized and plentiful, and communications are good. It can also be regarded as the limiting case of a mass double auction.[6]

The smooth functioning of a price system calls for many participants on both sides of the market. Thus, for example, in high density cities the supply and demand conditions for small restaurants or gift shops may meet the requirements. In modern societies, a mass of buyers facing a mass of sellers is rarely the case except in some financial markets. As development grows the mode of allocation of consumer goods becomes more oligopolistic on the supply side.

Oligopolistic competition with product differentiation and innovation. The demand for automobiles is generated by many individuals, however there are only a few firms selling automobiles. When there are only a few suppliers of a good the market is called oligopolistic, and the competitive price mechanism will not provide an adequate mechanism alone. The supplier side competition is in product differentiation and innovation.

The introduction of product differentiation and innovation in the market place can be best understood in terms of a dynamic chance-laden birth-growth-death process where much of the guidance and information comes from the financial system.

Practice, Context, and Theory

This brief survey has been given to provide a pre-historical and historical context for the emergence of an economy utilizing some form of a price system embedded in and guided by a government providing the rules, together with a legal system interpreting the way they are enforced in the light of the administrative structure and social norms.

All the different means for allocating resources are still extant (although hunting and gathering is minimal). They entered into use at different times as the size of population, the rule of law, and other aspects of civilization have developed.

Many of them do not call for the existence of markets or money but over time markets and money have emerged as an economical way to satisfy a large part of human wants. Along with this has been a great drive to develop measurements in terms of money. But this calls for extreme care as many aspects of human life cannot be easily quantified.

In practice **bargaining,** the **single auction**, and the **double auction** all lead to variants of a price system. In theory the assumptions behind the grand abstraction of the price system that proves the existence of a perfect Platonic set of prices that effortlessly and universally clear all markets are far removed from the context of the world in which actual markets function.

The elegance and austerity of the abstract understanding of the price system lends itself to provide a basis for deep misunderstanding and demagogic misuse. It is presented as a justification for an ideal untrammeled no holds barred, free from all supervision, market competition that ignores the context of the thousands of years of the growth of the political structure and its laws that enable the actual institutions providing the market mechanisms to function.

In these essays I attempt to offer the reader an insight into the profoundly important contributions to economic life made by the mechanisms of the price system while stressing the context, the need for laws and sociopolitical guidance that promotes their usefulness where they can be used and the alternatives where the competitive market is an inappropriate or nonexistent mechanism.

Some Guesses

In the measurement of human welfare and trade both **biological** and intra-family **transfers** of goods and services are hardly recorded. Generally, this does not matter; but it biases considerably the use of economic statistics in international welfare comparisons and encourages statements by the press such as “The average Haitian lives on a dollar a day.” Depending on the country, an attempt to monetize the not easily monetized might add anywhere from 15–70 or 80% of Gross Domestic Product.

Chance needs no separate accounting, except for pure gambling, as it is everywhere and is implicitly covered in the other methods.

The role of **gift** and other forms of *quid pro quo* that shade delicately into **bribe**, depending on the country could add between 2–15% to the product of an economy. Blatantly illegal activity, be it **theft, drug smuggling, tax evasione, bribery,** or other could account for anywhere between 2–20%. Allocation by **government** of any variety is essentially a fiduciary activity accounting for somewhere around 10–60% of an economy. My guess that one should start to worry about freedom of choice if central government revenues go above 20% or below 5% of GNP. A biological analogy is apposite. The human brain’s energy consumption appears to be about 20% of the body’s energy supply. Overall decision-making and control and coordination requires a substantial part of the energy of any complex system.

The emergence of a more or less formal **price system** dates at around 4,000 years ago. The Rosetta stone already shows trade’s need for laws including bankruptcy and contract. On the demand side of the market economy the individual consumer may account for anywhere between 40–70% of the direct demand.

Not factored into the comments immediately above is the role of war. It appears that if one considers as a war an armed conflict with at least 1,000 casualties there have been few, if any years of world peace.

Economics, Law, War, the Vote, and Taxes

The historical sketch has been presented to show that there are not only many ways to transfer resources that are still extant, but that the rise of the more or less anonymous mass market and the increasingly dominant role of finance and information are relatively new phenomena. The urbanizing world together with increasing specialization and division of labor lays more and more stress on the development of quick and efficient methods of trade. The lawyers, hopefully guided by economists are needed to frame the rules of the game for increasingly complex interlinked world economies. The viewpoints and functions of the two are highly different, but they both play a critical role in framing the appropriate socioeconomic means for resource exchange. They are key in providing the system with refinements in perception and case distinction and providing the preliminaries for the growth of meaningful and useful measurement.

At this time in writing Great Britain (or at least Little England) has been shaken with Brexit, a negative vote calling for exit from the European Union. Although world population growth and the changing technology of both communication and calculation call for the emergence of a far more sophisticated and unified world economy the gap is great between nationalistic voters led (or followed) by their politicians and advocacy for more international organizations with some surrender of nationalistic power. The current nationalistic pressures combined with the growth in lethality and speed of delivery of modern weapons has increased the probability of war as means to resolve political and economic differences.

Chapter 3

Custom, Law, Markets, and Measurement

The important symbiosis between law and economics is considered; but before turning to law and economics explicitly some comments on measurement are made as measurement and perception are critical in the interplay between law and economics in the development of measurement in economics.

The phrase Science is measurement is modified by the observation of Bertrand Russell (2001).

Although this may seem a paradox, all exact science is dominated by the idea of approximation. When a man tells you that he knows the exact truth about anything, you are safe in inferring that he is an inexact man. Every careful measurement in science is always given with the probable error ... every observer admits that he is likely wrong, and knows about how much wrong he is likely to be.

Carl Sagan (1995) observed:

> In the 1920s, there was a dinner at which the physicist Robert W. Wood was asked to respond to a toast.... "To physics and metaphysics." Now by metaphysics was meant something like philosophy — truths that you could get to just by thinking about them. Wood took a second, glanced about him, and answered along these lines: The physicist has an idea, he said. The more he thinks it through, the more sense it makes to him. He goes to the scientific literature, and the more he reads, the more promising the idea seems. Thus prepared, he devises an experiment to test the idea. The experiment is painstaking. Many possibilities are eliminated or taken into account; the accuracy of the measurement is refined. At the end of all this work, the experiment is completed and ... the idea is shown to be worthless. The physicist then discards the idea, frees his mind (as I was saying a moment ago) from the clutter of error, and moves on to something else. The difference between physics and metaphysics, Wood concluded, is that the metaphysicist has no laboratory.

Possibly Law and Economics could be regarded as without a laboratory, but the legal case books, empirical studies in economics and the growing body of experimental gaming suggests otherwise.

David H. Hubel a distinguished neurophysiologist noted, "Those who think 'Science is Measurement' should search Darwin's works for numbers and equations" (Squire, 2004).

When one contemplates developing sciences such as biology, perhaps a more reasonable way to view political economy is as an emerging science where in parts of it measurement is becoming feasible and the processes involving measurement are improving; but every science has its pre-measurement aspects where case history after case history serve to sort out the basic elements.

On Goods and Services

Some economically relevant physical aspects of goods are considered.

Individual Goods and Services

Much of basic micro-economics and the mathematical models for the study of the idealized competitive economy have been based on a highly abstracted view of what is a good or service that can be traded. There are vast bodies of law that distinguish among the properties of goods and services. Fungible chattels are goods that for trading purposes are identical, for example, a can of beans at a point of sale is not distinguished from the cans of the same brand, age and weight next to it. They are not only identical and movable; their ownership causes no obvious nuisance or aid to other than the owner. Many of the elementary expositions of the virtues of the price system involve a description of the production and exchange of such simple goods.

The apparent virtue of the ideal competitive economy is the existence of a set of prices that enable all individuals to organize production and exchange of a multitude of economic goods and services, with no other information needed. A whole body of elegant mathematical economics establishes this in several different ways;[7] but although the proof of existence of these prices is established, the dynamics and the coordination needed to find the prices is not given.

Many an ordinary individual sees that for the most part the market for most of the items for everyday living is far easier and more efficient than any bureaucratic rationing system that often is accompanied with a flood of paperwork. Those same individuals also see that on occasion prices in some markets, mostly the financial markets, can fluctuate considerably with a bad lack of coordination and a host of experts offering conflicting advice.

In static theory the power of a price system that covers the whole economy is phenomenal. In actual dynamics the theory does not tell the participants how price is formed and does not touch on the guidance needed and the cost of coordination.

Externalities

The price system in the market for consumer goods is a blessing and simplification for much of everyday life; but the control requirements for the evolution of price of a pound of bacon or a stock option on the shares of a high-technology firm are different. The markets both may meet all of the requirements for the static existence of an efficient price system but their dynamics differ. Society requires laws concerning hygiene in the handling of food products, and different laws are needed for stockholder protection against self-dealing in the issue of options. In spite of the free enterprise rhetoric there is no evidence that the society is better off waiting for the markets to correct themselves.

We also need to consider the economic goods and services where the requirements for the existence of market clearing prices do not necessarily exist.

Immovable goods such as land and houses and nontangible goods in the form of services have considerable bodies of commercial law covering and qualifying properties that proponents of competitive markets can easily overlook. These laws enable us to construct markets with prices. Roads, railroads, bridges, canals, the broadcast spectrum, nuclear power plants and disposal sites, to name a few, all pose many problems concerning joint ownership, indivisibility and how to charge for use. Here, once more a patchwork of legal structure must be provided by a society. For example, how to finance a toll bridge and to decide upon the nature of both the financing and size of the tolls calls for an *ad hoc* study of the physical facts, current and estimated future population densities and overall economic impact. It fits, in part into a price system, but not a competitive price system.

The rhetoric of politics is easily loaded with true believers. There is no problem that the imaginary free enterprise market cannot solve. The price system of the right is a magic wand in allocation. The true believers on the left have the magic state complete with selfless functionaries bring peace and plenty to the land with only a small piece for themselves. If prices exist they are calculated by philosopher-administrators rather than many competitors

Reasonable people of middle right or left persuasion recognize that the smooth functioning of the state depends less on the oratory and charisma of the promise-makers than the realities, work and functioning of an honest bureaucracy and legal system combined with open compromises and the availability of the technical experts who can convert words into realities.

The much quoted quote below, complete with its Anglo-French illustrates that the law has had a sensitivity to both economic and social context for many years. The trade-off had to be made between the economic value to society as a whole, and the damage to neighbors caused by a manufacturer

> A person may make use of his property or ..., conduct his own affairs at the expense of some harm to his neighbors. He may operate a factory whose noise and smoke cause some discomfort to others, as long as he keeps within a reasonable bound. It is only when his conduct is unreasonable, in the light of its utility and the harm which results, that it becomes a nuisance.... As it was said in an ancient case in regard to candlemaking in a town. “Le utility del chose excusera le noisomeness del stink.”
>
> — Prosser on Torts

At what point is compensation or prohibition called for, and how is it to be measured? The work of Ronald Coase (1988) is justly acknowledged as having been influential in merging law and economics in producing an economic, but not necessarily competitive market solution to problems with externalities. He managed to combine an uncommon common sense with a nice sense of humor while spearing pomposity in economic theorizing (see, for example, Coase, 1994). Much of his work was written prior to the development of the theory of games and many of his comments have been tackled with a far more powerful tool kit than he was able to use. This is discussed below in Appendix B where the concept of a simple but profound solution called the core is explained.

Public Goods and Merit Goods

Beyond goods and activities that generate externalities there are many communal goods including societal intangibles and tangibles. Among the former are defense and law and order. The mechanisms for their enforcement are tangibles that are generally expensive such as weapons, bases, training establishments, law courts, police stations, jails and a bureaucracy to administer them.

There are also an array of cultural institutions including religious establishments, universities, museums, and charitable institutions that do not fit fully into a competitive market structure. Given that the political structure has reflected public choice it is up to the lawyers to interpret the laws and the economists to advise on the ability and efficiency of the law and institutions to deliver the services and goods called for. A simple example is provided by art museums. They can be privately or publicly owned. The question of "should they be" is one that is answered differently in many nations. Many European countries offer the state owned institutions direct subsidies paid for by taxation. In the United States much of the subsidy to the museums comes from tax deductible donations primarily from the rich. In Europe it is the politicians influenced by their political constituency and a government bureaucracy who make the choice. In the United States the public has assigned much of the responsibility for the size of the subsidy to the rich. The demand side for the cultural institution does not fit easily into the conditions for a competitive price system; but the supply side comes much closer. Setting aside the cultural aesthetics and didactic problems with demand, the supply side of cultural institutions is subject to economic markets as much as any supermarket. Personnel must be hired and paid, inventories must be counted and evaluated; buildings must be maintained or reconfigured.

Possibly starting with Bismark's introduction of compulsory health insurance in Prussia in 1889 the modern nation state has added a list of "merit goods" to the list of goods and services to be provided by the nation state or other political subdivisions of the state. These may include health, education and a welfare net that protects all against penury. Musgrave (1959) introduced the somewhat fuzzily defined concept of merit goods to cover goods and service that the polity as a whole would like to see provided to all even though this might call for subsidies for some and taxes to others. I find the term "merit good" to be politically and socially loaded and unneeded for the analyst.

In medieval times these social services would have been provided primarily by the church and paid for by tithes. In making historical comparisons the economist and lawyer should keep in mind that the same function might be provided by different institutions at different times.

There are also "demerit goods" such as various types of addiction that damage not only the individual, but society as a whole.

As is indicated below a large taxonomy of public goods may be built up considering the basic properties such as appropriability, indivisibility, and many other factors that interfere with a pure price system.

An aside on why bad may sometimes be good. The immediate instinct of an economist dealing with theft, fraud and other crimes is to label them as bad. In the ideal world they are undoubtedly so all of the time. In the biological and ecological world, they may serve to cause the humans and, in the social world, the institutions to develop immune systems so that they are more robust.

On historic occasions such as the European occupation of the Americas, the invaders brought with them diseases for which their immune systems had built defenses, but the natives did not have these defenses and suffered accordingly. In a similar manner unprotected computer systems invite attack. Many of the advances in computer programming have been motivated to build defenses as counters to the evils of hacking.

Measuring the Incommensurable

Almost forty years ago Guido Calabresi and Philip Bobbit (1978) wrote a brief book entitled *Tragic Choices*. They considered how a society can deal with choices involving life and death, using as their examples the allocation of kidney dialysis machines; national military conscription in wartime and entitlements to have children.[8] A series of articles by Kip Vicusi and associates (Vicusi, 2000; Viscusi and Aldy, 2003; Viscusi, Magat and Huber, 1989) have offered estimates of the monetary worth of life in many different occupations and situations such as automobile safety, airline deaths, cigarette smoking, air pollution, and bicycle fatal head injury. Predating the modern concern with how to evaluate the worth of a human life there is a history and tradition of "blood money" as a form of restitution in many cultures.

Weregelt in old Scottish law is a manifestation or a price evaluation of a payment for a crime of violence to settle accounts without resorting to violent reprisal. The payments varied according to social station and sex.

A brief table of some of the different economic evaluations of the worth of a life (or death) is given in Table 3.1.[9] The highly different valuations on life in different contexts are striking.

Table 3.1 The various worths of life

Context	Value ($millions)
Automobile deaths	1.5
Airline deaths	15.6
Cancer	2.6
Cigarette smoking	0.9
Smoke detectors	1.2

The price of a life, or death[10] in a wonder world of perfect equilibrium should all be the same for faceless identical individuals in a context free abstraction; but clothed with the ever evolving aspects of human society they should, can be and are highly different. Life is lived primarily locally and the many evaluations of the value of life account for specific individuals, in time and place. The employment of lawyers, notaries, economists and forensic experts is not a quaint

institutional fact in contrast with pure theory, but a proper application consistent with theory. It is labor intensive to put in all the relevant details, to identify and debate as to how to clarify the unclear aspects of each special case, including biases of the society concerning different forms of death.

The great British economist Francis Ysidro Edgeworth (1845–1926) in his inaugural address phrased the basic contrasting of economic theory and practice most eloquently as follows:

> It is worthwhile to consider why the path of applied economics is so slippery; and how it is possible to combine an enthusiastic admiration of theory with the coldest hesitation in practice. The explanation may be partially given in the words of a distinguished logician who has well and quaintly said, that if a malign spirit sought to annihilate the whole fabric of useful knowledge with the least effort and change, it would by no means be necessary that he should abrogate the laws of nature. The links of the chain of causation need not be corroded. Like effects shall still follow like causes; only like causes shall no longer occur in collocation. Every case is to be singular; every species, like the fabled Phoenix, to be unique. Now most of our practical problems have this character of singularity; every burning question is a Phoenix in the sense of being sui generis.
>
> —F. Y. Edgeworth, 1891

Not only do I concur with this observation, but that the act of converting a timeless static equilibrium model into a playable game forces us to open the elegant but lifeless static model to its environment. Little details like default rules, inheritance rules, accounting rules emerge even at a minimalist level as necessities in constructing a minimally viable organization. There may be a vast array of minimal organizations reflecting the ecological richness of an economy embedded in a polity and society, but these all still obey the general laws.

The work of law and economics is time consuming and practical. Each individual case disappears into the records after it has been resolved in a way that a good meal that took considerable time and expertise to prepare. The instance serves its purpose and life moves on; but the accretion of annotated cases provide the data and experience that help to clarify and resolve new cases that may arise. The by-product of the special practice is to qualify and provide an approximate monetary quantification that only the foolhardy would pretend can be used out of context.

When successful the law and the economics achieve two allied but different goals. The first goal is a working solution that should mollify the passions of all parties. A sense of satisfaction that leaves each party with some perception of gain is usually a good solution even in a culture whose politicians prefer to talk about “win or lose” as though society, its law courts, market places and wars are all zero sum games. The second goal is the production of a better measurement or pre-measurement of the basic aspects of the problem at hand.

Structure, Intent, and Behavior

The view of the English social philosopher, political economist, Jeremy Bentham (1748–1832)

was that the goal of all individuals was to maximize happiness. He believed that one could at least attempt to measure pleasure and pain considering various dimensions such as duration and intensity.

He may be regarded as having been the father of the use of the concept of the maximization of utility that has played a central role in economic thought since his time. No one has ever seen or successfully measured a utility function that they believed in; and in the late 1930s through to the 1950s economists built an elaborate theory of consumer choice arguing that the utility function was an unnecessary concept (see, for example, Hicks, 1939). All one needed to describe economic behavior was that people had well defined preferences. This seemed to work reasonably well in describing some choice at the grocery, but not for situations such as buying a house or a used car where uncertainty is involved. It also appears to be inadequate where there are new products and salesmen try to set and manipulate taste.

In many instances it is extremely hard to deduce preferences and intent from behavior. The consumption of evening drinks after one's New Year resolutions to go on the wagon and stop drinking provides a case in point. In considering sentencing for murder, a judge may take into account the possibility of a crime of passion or of a cold blooded murder and whether or not there is any display of remorse from the murderer. These call for judgments and evaluations beyond that of the economist even though a pure utilitarian follower of Bentham might try to fit them into the same mold.

Macroeconomists such as Keynes and the founding behavioral economists such as Herbert Simon at Carnegie Institute of Technology were willing to cut the Gordian Knot and use behavioral approximations that could be regarded as "good enough approximations" of the behavior being considered without having to connect the behavior to a formal optimizing model of intent.

With the growth of game theory, experimental gaming, computer science, operations research and mathematical economics an interest in design of mechanisms has emerged. Can we design rules, laws, mechanisms or institutions that provide appropriate structures such that the broad or narrow class of users for whom the mechanism is designed will do more or less, the right thing without the designer having to worry too much about the detailed motivations of the individuals? These mechanisms and institutions include toll booths capable of being used easily and efficiently by most of the technically untrained drivers; savings and insurance institutions that perform their functions for some appropriate bandwidth of economically literate individuals with other institutions targeted at servicing the less literate. An example in many countries has been the existence of Post Office savings accounts designed to promote safe and trustworthy savings among the poor and economically illiterate without bank accounts. From 1911 to 1966, the United States had such a facility.

Political Economy is a complicated subject and the debate between normative and positive or purely empirical views of what constitutes a useful model will continue. This chapter is purposely both historically oriented and broad in scope in order to set the context for the development of the basic thesis that there is indeed a fundamental abstract economic theory that

is worth developing and analyzing; but the gap between the theory and application can only be closed by the introduction of the appropriate details concerning both structure and behavior in order to address the *ad hoc* questions that must be specified to make application worthwhile.

The Many Facets of Public Goods

We close with observations on the need for a taxonomy that indicates the scope of the instances where the goods and services involved do not fit simply into the rubric of competitive markets. Any one of the many instances noted can be, and is resolved daily by a society utilizing the efforts of lawyers and economists and other experts dealing in the details, resolving the inconsistencies and considering the basis for the precedent in handling the processes encountered. The resolution is not immutable but it serves in providing an answer here and now to a problem that may return in a new manifestation later, where at most the current resolution may have provided extra precedent for the next problem.

As the complexities of economic dynamics emerge set in the context of the social, political and legal realities of each society, the many nuances about the concepts of individually and partially or completely jointly owned or intertwined goods and services, and the cultural and moral dicta of the society must be dealt with. They form a spectrum from simple and relatively easily handled items such as the clear generation of nuisance, to deep moral evaluations such as evaluating assisted suicide, or striking a trade-off between freedom of the press and the need for terrorist surveillance.

How to Classify "Goods and Bads"

Many consumer and producer goods and services are easy to describe, classify and measure. Oranges and butter provide good examples. We can attach straightforward properties to a decent first approximation that make it possible to specify what we mean by a pound of bacon, or a gallon of gasoline of a given grade, or of a liter bottle of rum of a specific brand. The quality of justice and the measure of freedom do not fit in as easy to measure items.

Prior to attempting to measure, we may try to construct a taxonomy to bring some order to our thoughts about a mass of disparate items as was first done in botany by Linneaus (1707–1778), the father of taxonomy. Taxonomy is the classification of a set of objects according to sets of properties they may possess in common. It provides a pre-step towards measurement.

In considering the various classes of goods, services and entitlements some with imponderable aspects we may construct a broad taxonomy by specifying the factors that can complicate or rule out the use of a competitive price system as their means of distribution.

In the 19th and 20th centuries, possibly climaxing around the 1940s in a radio show, the game 20 Questions was popular. This simple game helps to illustrate the idea of a taxonomy. One person selects an object such as an orange or a Rembrandt picture or the scent of the sizzle from a grilling steak. The questioners have 20 questions that must be answered Yes or No, in order to deduce what item the individual has in mind. In the instance of the orange, the questions might

go like this: “Can the item you are thinking about be owned by an individual? Yes. Is it edible? Yes. Do you need to cook it to eat it? No.” Each question should be designed to cut down the uncertainty about what the item could be.

A biological taxonomy does not have to be Yes or No. There are several sets arranged in order from which by choosing a single item in each set we can narrow down to where the human being is located among all living organisms. A conventional biological taxonomy has eight levels for living organisms They are Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species. Homo sapiens can be categorized as Domain Eukaryota, Kingdom Animalia, Phylum Chordata, Class Mammalia, Order Primates, Family Hominidae, Genus Homo, and Species Homo sapiens.

There are many problems with biological classification systems, but the subject is reasonably advanced and helps biologists to communicate with each other and jointly know what they are talking about.

The legal profession in the search for precedent has a somewhat different need than the biologists for an organized and categorized body of legal cases than can be researched easily for use in case law.

The lawyers also require an appropriate compilation of statutory law.

When we turn to economics the animals in the economic zoo have scarcely been categorized. Words, such as monopoly, duopoly and oligopoly are tossed around, and attempts have been made to produce an index of concentration in various industries; but even the concepts of what is meant by an industry or firm remain vague.

This is not the place to attempt to devise one or more economic taxonomies as useful as the one in biology. The basic point to be made is that no matter how general is the theory, all applications are special and although general theory may be of great help in organizing and analyzing the facts, the need to know the facts in sufficient detail is a necessary, but not sufficient requirement.

Chapter 4

A Preliminary to Understanding Markets and Competition

Chapters 2 and 3 have been devoted to sketching the broad context of the resources required for the complete life. Custom, religion, politics, law and war provide much of the context for human existence. In the remaining chapters we are constrained to the more mundane tasks of showing the benefits and limitations of having a society use a market economy when it is possible to do so, together with the critical role played by money and law; and how money emerges as the natural instrument to provide the flexibility needed for a dynamic economy.

Statics or Dynamics?

The development of economic theory from even before Adam Smith and certainly after, has taken place utilizing the essay form. Furthermore, some form of dynamics has been sketched in virtually all of the essays. They permit "Great man approaches" to societal and economic theorizing. Thus we have Hobbes, Thomas Aquinas, Clausewitz, Sun Tzu, Darwin, Freud, Gibbon, Hegel, Nietzsche, Machiavelli, McKinder, Malthus, Mahan, Marx, Keynes, Sombart, Schmoller, Parsons, McLuhan, Schumpeter, Friedman, Hayek, Hilferding, Toynbee, Pareto, and many others. The common thread is that each came with a grand system to offer that explained some overall view of the workings of the world. A few on, this eclectic list have stood the test of sufficient time to have had the dross leach away and have emerged as towering figures over the centuries, while others are scarcely known to current society having, like minor comets, been seen in some moment of glory and then disappeared into the outer darkness. Just about the only features that their lives and personalities appear to have in common is a single-minded vision and a gluttony for work.

In a highly complex ever changing world a feature that is of high importance today may disappear sometime later. Possibly it may return years or decades later in a slightly new form and new politicians and popular writers will reinvent their own promised new cures and present them ignoring history. The disconnect between politics and professional knowledge in economics remains high.

In the last two centuries the social sciences have started to head more towards science and away from oratory. In political-economy the practitioner-theorists such as Keynes were well aware of the value of a well-turned phrase; but the tension between science and political rhetoric still exists. The social scientist who wants to influence policy now and directly is faced with knowing how to work with politicians, and to maintain scientific integrity while doing so. This appears to be easier during war than in peace.

By the mid to late nineteenth century the use of mathematical and diagrammatic models appeared in the works of Cournot, Jevons, Walras, Pareto, Edgeworth, and others, and with Alfred Marshall verbal dynamics were re-enforced with diagrams and a discussion of comparative statics. This comparative statics is neither statics, nor full dynamics, but a hybrid

where like in the early Muybridge photography of motion, one did not have actual motion but two or more fixed pictures of the system taken at different times. Then like the photos of a process such as running, the economist provided a verbal description using the different static diagrams to explain how one “is able to get from here to there.”

I break my vows on banning all figures and matrices from this book, by using two simple figures here and a few later on, and one matrix example below, but that fills my quota. A concrete simple example is given below using a standard comparative supply and demand analysis often given in elementary economic textbooks. In Figures 4.1 and 4.2 the horizontal axis labeled *q* shows the quantity of a single good for purchase or sale. The vertical axis labeled *p* shows the price of the good for sale or purchase. In both diagrams the curve indicated by *SS′* shows the price as a function of supply and the curve *DD′* show the initial demand. Figure 4.2 also has a second demand curve $\overline{DD}'$ that represents a shift in demand for the good.

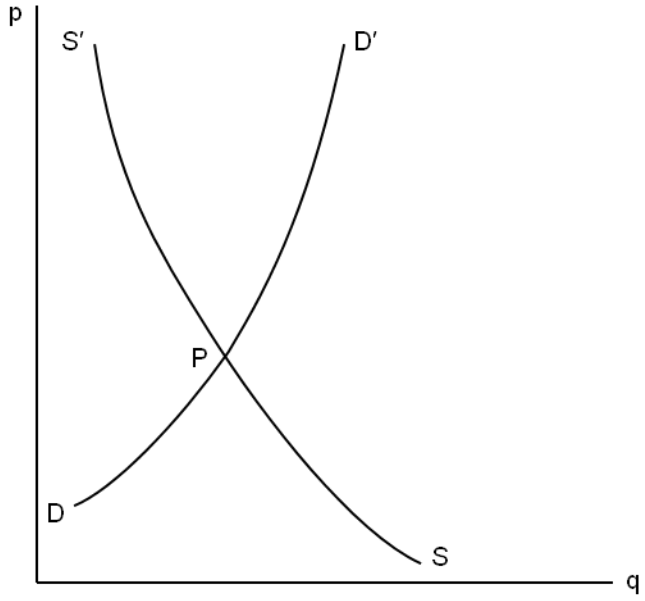


Figure 4.1. Equilibrium supply and demand

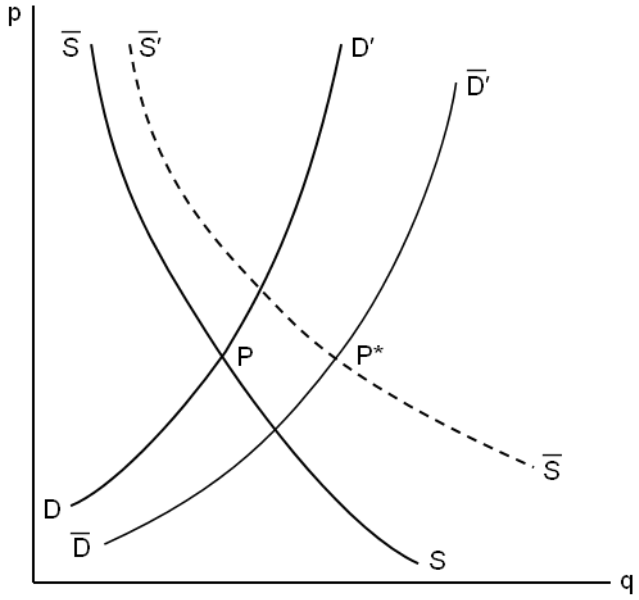


Figure 4.2. A shift in supply and demand

The crowning joy of elementary economic supply and demand analysis is to show what the final price will be. Looking at both diagrams we may invoke the mantra on unconstrained competitive equilibrium and state that the prices will be *P* given as the point of intersection between supply and demand, followed by $\overline{P}$ when the demand has shifted to $\overline{D}D'$. How the price gets from *P* to $\overline{P}$ be part of a "just-so" story that teachers of the first course in elementary economics bestow on their audience. A great teacher such as Alfred Marshall did not short change his pupils, the diagrams are simple, but the stories told about them are complex. He might say that the shift in demand was sudden and that as the industry had no time to react price would fall quickly to $\overline{P}$; however, after some time (depending on the industry he was talking about) the supply would change as the firms changed their production plans and supply would also move from SS' to $\overline{S}\overline{S}'$ hence the final price would settle down to P^*.

This little tour of how price went from *P*, dropped to $\overline{P}$ and then settled higher at P^* gave many an undergraduate a deep appreciation of both the simplicities and the subtleties of economics, but the businessman looking for help needs to know more or less what those dynamic supply and demand conditions in fact look like and how long would it take to go from *P* to $\overline{P}$ and then from $\overline{P}$ to P^*? It might happen that if the down market change times were long he might go broke in the process.

It was not just the businessmen but the younger economists who started to wonder if this type of story could be quantified.

The Rise of Mathematical Economics

> Make it as complex as you like, as long as you keep it simple!
> — An executive officer mantra

The need to become more formal than an essay has been manifested in the rise of three new divisions in economic theory. They are microeconomics, macroeconomics and econometrics. Each aimed at different but allied problems in the understanding of economics.

Microeconomics is the study of the actions of individual natural persons, firms and other decision-making economic institutions involved in trade, production and consumption. Any number of markets and goods and services may be considered. The viewing of the whole economy as an enormous group of interconnected individuals and institutions with full feedback among all of them is attributed to the great French economist Lèon Walras (1834–1910) (1954). By full feedback we mean that all parts of the economy may have some direct or indirect influence on any other part of the economy that in turn may react on the initiators. Walras offered a mathematical representation of the economy as a whole, at a high level of abstraction. Unfortunately his mathematics was not good enough to demonstrate all the circumstances under which his conjecture concerning the existence of market prices such that the whole economic system would be efficient and decentralized by the prices.

Like many other prominent economists Walras lived a solid upper middle class life, although financially threatened by the long illness of his first wife. Born in Normandy, a graduate of the Ecole de Mines, one of the great schools for producing French top bureaucrats. He spent many years as Professor of Political Economy at the University of Lausanne

After the World War I and the subsequent booms and crashes, mainly under the impetus created by the writings and advocacy of John Maynard Keynes (1883-1946), (1936) the subject of macroeconomics emerged as a topic of its own, closely associated with a revolution in the gathering of governmental statistics and the creation of national accounting systems. Its emergence was aimed at the highly practical problems of trying to control unemployment and to manage the unstable business cycles that appeared to cause great instabilities in the economy. The driving idea behind macroeconomics was to portray the dynamics of the economy by dealing with great aggregates of individuals and firms as though they were each a single or representative agent that portrayed the behavior of large groups of individuals. This idea is methodologically acceptable in physics where it has been shown empirically that for some problems it yields verifiable approximate results. Unfortunately the results in economic practice still leave much to be desired; nevertheless in the course of the years since World War I and especially after World War II the number of macroeconomists has grown from a handful to many thousands.

Keynes was from an upper-middle- class family, a pupil at Eton School followed by Cambridge University. Not only was he a powerful polemicist, debater and writer, he was a member of the Bloomsbury Set of artists and writers who in reaction to the mores of the Victorian era openly espoused homosexuality and loose sexual relations. He was an avid supporter of the arts, in

particular the ballet. In 1925 he married Lydia Lopokava a Russian Ballerina. They had no children. He died of heart failure at the early age of 62.

Applied macroeconomics has many scientific aspects to it, but there are many divisions from the extreme right to left of the political spectrum and given the complexity of any economy and the society in which it is embedded it is easy for two reasonably honest macroeconomists of different political persuasion to select two somewhat different mathematical models of the same economy and it is extremely difficult to show empirically over any reasonable amount of time which is a better representation.

A key observation for us to make is that all macroeconomic models involve the government as an important agent in the economy; furthermore money and credit, taxes, subsidies and interest rates are almost always important controlling factors in the models considered.

The third major development in modern economics was econometrics. This deals with how one obtains quantitative information about economic life and devises statistical methods to interpret what this information means and how it provides insights of value both in practice and in the development of economic theory. How does one actually measure the overall demand for eggs, or bread or apples or automobiles as a function of price and the wealth of the purchasers? How can we construct a cost of living index, and what faith should we have in it? These are all basic questions that are extremely easy to ask and highly difficult to answer in an operationally useful manner. The Norwegian economist Ragnar Frisch (who won the first Nobel Prize in economics in 1969) coined the term Econometrics. It is the workhorse for all modern economic applications. In the discussion here we take its existence for granted and do not delve further into this rich, important but highly technical tropic.

Frisch was the son of an Oslo gold and silversmith and was expected to go into the family business but instead went into economics with moderate mountaineering and passionate bee-keeping as sidelines. He died in Oslo at the age of 77, survived by his second wife.

A Game Theory Basic Model

It is a fact of life and a rule of publishing that the appearance of symbols and mathematical structure causes the eyes to glaze over for many nontechnical readers and the reader stops at that point. Unfortunately it is often the case that complex phenomena are really complex and in spite of cheerleader statements that any complex phenomenon can be explained fully to any lay individual who has not done the necessary homework, the truth is that the best of expositors can offer an appreciation and some understanding; but without the study of enough of the appropriate technical language the reader will not be able to attain a deep understanding. The compromise utilized here is to try to stay simple, but provide references and notes to those who would like more depth.

Fortunately virtually no mathematics is needed to illustrate some of the basic concepts that we need from game theory. The ideas are offered below using one simple example of two individuals playing a game where each can choose one of two actions that lead to four different

outcomes and each individual can evaluate the worth of what he or she gets at any outcome.

The Rules of the Game

Although pure mathematicians can and do write down mathematical models with no contextual description whatsoever, the simple example presented here is given with a highly simplified economic context of two large firms each selling a highly substitutable product in the same market where entry by other firms is sufficiently difficult and expensive that we can forget about them. Limiting ourselves to two alternative moves for each firm to charge a high price (HIGH) or a low price (LOW) we can represent the whole situation by an array we call a 2×2 a payoff matrix that can be interpreted as follows:

Table 4.1 Price cutting

A/B	HIGH	LOW
HIGH	100, 100	150, 30
LOW	30, 150	50, 50

Firm A has to decide on a high or low price; so has firm B, and they both disclose their choices simultaneously. It is evident that there are four outcomes or boxes in total (HIGH, HIGH), (HIGH, LOW), (LOW, HIGH) and (LOW, LOW). Each of these boxes contains two numbers, the payoff to Firm A and to Firm B. Suppose that both A and B chose HIGH then the payoff from a market in which both maintain the high price outcome is $100 million to each, If instead one firm chooses LOW while the other chooses HIGH, the outcomes would be (HIGH, LOW) or (LOW, HIGH) and the payoff to the price cutting firm would be $150 million, while the firm that lost market share would have a payoff of $30 million. If both cut price they would end up with payoffs of $50 million each.

This is obviously a gross simplification of reality, but as a reasonably simple parable it shows several home truths. When there are only a couple of firms involved they are far better off cooperating, or coordinating or colluding to keep the prices high, than undercutting each other. If they undercut, even if both survive they make far lower profits at a low, equilibrium price. We say “equilibrium” because looking at that outcome neither firm has any motivation to change its action. In contrast at (HIGH, HIGH) if both firms act individually they are each motivated to risk price cutting. Reams of legal decisions on implicit or explicit collusion have been based on whether one can establish implicit or explicit collusion if the firms choose the HIGH price solution. This little homily is hardly enough to provide more than a glimpse into formal game theory, but it is already enough to begin to formalize concepts such as moves, choice sets, outcomes and payoffs[11] and turn them into technical terms that make them easier to analyze mathematically.[12]

Several Paradoxes about Competition

The example above was given from the viewpoint of the firms. From the viewpoint of the economy as a whole all the citizens must be considered including consumers, workers and owners. When they are added to the analysis it easy to see that most consumers generally stand

to gain by the lower prices. At this point several new problems appear. They are: (1) **the oligopoly problem**, (2) the **innovation** fix, and (3) the overall difficulties in the **coordination** of the different time lags in the economy. Noted are three names Chamberlin (1933), Schumpeter (1934), and Keynes (1936), among the many economists who tackled these different aspects of the economy. Two are well known to a broad public and one is a lesser light known mostly by other professionals.

Edward Chamberlin (1899–1967) at Harvard is the lesser known economist who argued that price is not the major weapon under the control of any firm, but every firm will strive to differentiate its product from all others, thereby creating at least a weak monopoly for itself. In modern marketing terms this is involves developing one's own brand name or reputation. This differentiation lessens the blow caused by a competitor cutting prices. Although he did not fully do so he, Chamberlin's model of monopolistic competition could be converted into mathematical models and one could start to ask how to measure the power of different partial monopolies.

Schumpeter who eventually settled in Harvard in the 1930s and stayed there until his death was earlier than Chamberlin in his advocacy that price was by no means the key weapon in economic competition. He adopted a far more biological viewpoint where innovation of new products created whole new industries and wiped out old ones in a great ecological struggle. In the battles among producers price wars might break out, but they were also accompanied with great changes in costs and swings in demand. Schumpeter to this day remains the prophet of innovation (Schumpeter, 1934; McCraw, 2007). His essay description of innovation was highly complicated, completely qualitative and heavily dependent on finance. Although he advocated the importance of mathematical models and quantitative investigation he lacked the abilities to take these next steps with his own work.

Joseph Alois Schumpeter was born in 1883 in Triesch, the son of a factory owner who died when Joseph was four years old. His mother moved to Vienna with him in 1893. At the University of Vienna he was a student of Eugen von Bohm-Bawerk. In 1919 he briefly became Minister of Finance of the newly formed Austria and then was involved in private banking. From 1925 to 1932 he was a member of the Faculty at Bonn, moving to the United States to Harvard in 1932 where he remained for the rest of his life and was aided considerably by his third wife Elizabeth Boody an economic historian who brought his (and her) enormous History of Economic Analysis to publication after his death. He died in 1950 at the age of 65 at their home in Taconic, western Massachusetts. Along with his talents and originality in stressing innovation came a substantial ego and an ambition to be a world class horseman.[13] The Schumpeters were childless.

Like Schumpeter, Keynes was heavily influenced by his experiences and views of the economies prior to and after World War I. Keynes approached the economy from a viewpoint far different from both Chamberlin and Schumpeter. They were interested primarily in the microeconomics of competition even though Schumpeter also wrote about business cycles. Keynes was interested in the overall critical problems of **coordination** that existed for the economy as a whole. He recognized that natural persons played many roles, and that at the very least aggregates of individuals representing the whole population broken into firms, workers, consumers, managers,

owners, government, and politicians had to be considered. One also had to adjust any model to take into account international trade. Keynes, like Schumpeter wrote primarily in the essay form; he had far more mathematical ability than Schumpeter, but he chose to use next to no mathematics as he was far more interested (and initially less successful) in persuading the public, the bureaucrats and politicians than he was in dazzling the readers of the academic quarterlies.

From the late 1930s onwards mathematical models, national and international aggregate accounting schemes, and some highly mathematical models as well as many computer simulation models, some containing hundreds of equations have been constructed. These simulators take many equations representing updating rules of motion for many agents in the economy. They portray expected conditions such as how much we expect a representative family of four will spend next period if it earns $80,000 a year. The growth of computers and data banks have enabled economists to try to model many aspects of the overall economy, such as employment broken down into several categories and then constantly estimate and re-estimate the structure of the equations and actually solve them computationally or have the computer trace through step by step the behavior of the economy and bury the economists with reams of paper with graphs and tables that they may or may not be able to interpret in a satisfactory manner.

High Employment for Economists and Lawyers

The three viewpoints presented above all have elements of truth that anyone living in an economy with some markets has seen, but each one brings with itself a host of difficulties that have to be solved if economic behavior is to conform to political needs and bureaucratic reality. When does monopolistic competition become too monopolistic? What patent protection, if any, should be offered to innovating firms? When does innovating behavior become predatory behavior with the large firm using larger resources to destroy the smaller firms? Pure theory will undoubtedly give a weasel-worded answer such as “it depends.” Good practice gives as good an answer as it can to each specific question by employing a battery of lawyers, accountants and economists looking at the *ad hoc* problem. The solution is part of the process of getting from here to tomorrow with the relevant parties having worked out an accommodation they can live with. The lawyers, accountants, and economists embroiled in the ever ongoing litigation are far more than bargainers, they are part of an overall perception and measurement device that adds and evaluates the specifics that the theorists have to gloss over.

All three approaches noted above are dynamic and all three have government in one form or another playing a role. When does government become “big brother”? When is it too big or too small? Each grand theorist or political true believer may offer a pontifical answer. The more scientifically inclined economist can answer honestly, but only with some truth-in-packaging labels. If we take as an assumption that the society, through its political system favors a minimum income or a basic health care package for all, the answer goes one way; if in contrast the stress is on individual responsibility at all levels, the scientifically honest economist must, in general, provide a different answer.

The Ideal Pure Competition: General Equilibrium

The dream of the laissez-faire libertarian idealists is an economy with little government interference, with many producers and consumers all in smooth, essentially anonymous competition with each other via a smoothly functioning, almost invisible set of interconnected markets. The markets are so good that each individual does not even have to consider that he or she is in direct competition with others, but is confronted with a universally known set of prices for all goods. The individual can forget other people and personalities and merely maximizes his or her own welfare and the invisible mechanism of these interlinked markets gathers and redistributes all goods for sale costlessly and without error in such a manner that the magic of the markets matches all buyers and sellers perfectly. The miracle of the existence of a competitive equilibrium is such that at least one set of prices emerges that permits supply to equal demand in every market.

If all of the above happens to be true then a marvelous intellectual basis is provided for the support of the free market. Fortunately it is true, but unfortunately only in a limited context. As happens often, the gap between the popular and political rhetoric and the scientific reality is large and charismatic leaders or well-placed bureaucrats who want to get on with running the world do not want to read the footnotes, qualifications and the ifs and buts that often accompany and qualify any deep scientific insight.

The prophet calling for the establishment of the mathematical proof of the existence of competitive prices was Walras, but as has already been noted, his mathematics was not up to the task, and what is even more important his verbal embellishments about the nature of the overall economy did not fully match his mathematical ideas. He was talking about a dynamic economy that utilized money and credit and had a government sector; but the construction of such a model in any generality is extremely complex and remains so even today.

In the 1950s three mathematical economists, Kenneth Arrow (Arrow–Debreu, 1954), Gerard Debreu (1959), and Lionel McKenzie (1959) all tackled the mathematical problem of proving the existence of the price system advocated by Walras. But in doing so and obtaining a mathematical model that was rigorous and would be regarded by any mathematician as logically tight they made many simplifications that implicitly warned the readers against broad application to an actual economy without considerable care and appropriate modifications. From the point of view of the law the price system appears to work well for fungible chattels, or goods where any one unit appears to be perfectly interchangeable with any other unit, it is moveable and its ownership can be transferred from one individual to another with little difficulty. In contrast real estate, houses, factories and heavy machinery involve heavy expenses in their transfer. New economic instruments and institutions are required to create reasonably efficient markets for these items.

The epitome of a new high level mathematical economics book was attained by Gerard Debreu (1959) in his publication of *The Theory of Value*. It was thin, precise and began with a many page lecture on the type of mathematics used. Debreu had been at the mathematical economics research center, The Cowles Foundation, but when he was not promoted to full professor at Yale he left for an appointment as professor at the University of California at Berkeley. He was

personally as precise as his book. A visitor to Gerard's office at Berkeley would note that when he left every book would be in its place and his desk would be completely clear except for a single pad of paper in the center of the desk, perfectly aligned with both sides and a perfectly sharpened pencil was lined up next to the pad.

Gerard Debreu was born in 1921 in Calais. He was orphaned at an early age with his father a suicide and is mother suffering an early death. He weathered the vicissitudes of getting an education in France during World War II in 1945 he married Francoise Bled and had two daughters born in 1946 and 1950. A few year before his death he abandoned his wife and left Berkley and returned to Europe where he died in 2004 in Paris at the age of 83 and is buried in Pere Lachaise where the French bury many of their famous people, even though he was an American citizen.

Although these essays are by no means meant to be professional economic history rather than presenting a bloodless picture of all of the actors I supply, on occasion a sketch of some of the major people involved. All of science is done by people and many come with large egos and drives. At least a minor sketch of who they were helps to provide context.

With all of the care and precision needed to formulate a closed economic model with all markets interacting a strange event took place on the way to proving a general existence of an efficient price system, the baby was thrown away with the bathwater. The existence of prices was proved, but in the models of Arrow, Debreu, and McKenzie government, dynamics and money, all of which were present in Walras had disappeared.

In mathematics there are two different types of proof that may be used. They are known as existence proofs and constructive proofs. An existence proof applied to the price system can establish that an efficient set of prices has to exist but it does not provide the reader with an explicit way to find these prices. A constructive proof tells us how to find them. This may look like a minor technical difference, but in practice it is enormous. Without a process to calculate efficient prices one cannot tell the difference between an ideal competitive economy and a centralized socialist economy where big brother has a central economic planning board that calculates the appropriate prices and announces them to all firms and consumers. Without a process description telling us what happens out of equilibrium the informational and bureaucratic conditions that distinguish efficient competitively determined prices from centrally planned prices are not there. In the 1930s at the London School of Economics Oskar Lange (1938) and Abba Lerner (1937) suggested that planners in a socialist economy could use prices. There was the inconvenient detail of gathering the appropriate information from which to calculate these prices, and Friedrich Hayek (1899–1992) (1944) rightly pointed out that the information requirements were no minor detail.

In spite of its limitations the mathematical model of a general equilibrium efficient price system was an important way station in laying out the anatomy of an economy; but by considering only the equilibrium position without specifying process the uncomfortable problems with assigning causality to what is going on and the need to worry about money and centralization disappeared.

Where Did the Money Go?

We have laid out four different approaches to the modern economy, the price system of Walras abstracted by ADM and presented in a nonprocess, noninstitutional form; the monopolistic competition model of Chamberlin (and a highly related model by Joan Robinson, a British economist); the macroeconomic models initiated by the work of Keynes; and the verbal descriptions of the innovating economy proposed by Schumpeter. The first was the most mathematically advanced, yet without any trace of process. The last three all involve process, and money and implicitly or explicitly, money and credit. The challenge to be considered here is how to put money, credit, process and government back into the general equilibrium model at the same level of mathematical and logical precision as the work of the new mathematical economists and then link this with all three of the dynamic theories noted in order to start to build a theory of economic process.

Even casual observation tells us that money and credit are at the very heart of economic dynamics. This is not a minor academic problem, but is central in permitting us to link abstract theory with concrete application. As we shall see below money and credit together with the default and bankruptcy laws provide a means to constrain the dynamics of an economy in perpetual disequilibrium. **It is not equilibrium seeking, but if it has any joint aim whatsoever it is for arbitraging out of the system any opportunity for profit that passes by.**

Chapter 5

Markets and Minimal Financial Institutions

Chapter 4 dealt with clearing the underbrush. The abstract model of general equilibrium was without process and pre-institutional. It was counterfactual, but useful to promote clear thinking about the potential power of markets and prices in being an information parsimonious way to conduct exchange for many of our everyday needs.

Contingent Markets

In the ideal world that was presented not only was the basic model without money and institutions, but a very clever mathematical dodge was used to avoid having to face up to the unpleasantries of time and uncertainty and capital goods. In the need to show, at least formally where these complicating realities fitted into the abstract scheme of things, the idea of a time dated contingent commodity was invented. This was a piece of impeccable logic that multiplied the number of commodities by time and chance. Thus the model does not merely contain a commodity called wheat or copper that you could buy or sell; but it also includes contracts that are synthetic commodities that we can call wheat or copper futures contracts that say implicitly if everyone is able to evaluate all future events perfectly they can trade futures contracts with each other and attain the hedge fund manager's dream of a perfectly hedged portfolio for all. My father, who was a not particularly successful merchant or abstract thinker on being told by me about this type of mathematical modeling stared in disbelief and queried "From this sort of stuff you can make a living?"

The idea of the contingent commodities mixed fact and fiction; however, in this imperfect world futures contracts do exist and they are available for individuals who really want to hedge against certain dangers that could harm their firm such as swings in foreign currency exchanges (FX) when the firm's major customers are abroad. The desire to hedge allows for professional brokers or traders to find a big enough supply of bets on FX to be able to make a good living matching these bets and earning on a spread between bids and offers. The dynamics of efficient matching procedures is a lively and productive sub industry consistent with mathematical economics.

Incomplete Markets and Transactions Costs

Unfortunately predicting the future is a highly imperfect art loaded with error. While it is comforting to know that in theory if markets for every sort of contingency existed and they were all evaluated correctly perfectly competitive prices would exist both for all goods and paper contracts this is not an adequate description of reality. The actual state of affairs is of a society with incomplete markets and an imperfect ability to hedge all risks.

The economics profession likes to talk about **transactions costs** as though they are not production costs. They are in general the (often unspecified) actual costs of carrying out exchanges. To most of us who live in a world where any exchange involves at least information and transportation, the costs of carrying out an exchange are as real as the costs in manufacturing

steel, or weaving cloth. Any exchange involves the use of labor and other resources. They are left out of much economic theorizing as they make the models too hard to specify, and if one can argue that they are very small it is legitimate to ignore them. They rarely are small, but are often hidden in the pricing structure.

Markets or Barter?

The intuitive idea of barter is of face to face encounter between two individuals or possibly two small groups where one side trades a quantity of beaver skins for some quantities of, say, cloth and salt. This contrasts with a mass market where many essentially anonymous individuals offer to sell cloth and a large anonymous set of individuals bid various amounts of a money for the cloth that is offered. Somehow or other in the process of this mass and essentially anonymous trade among a large number of agents a market price emerges and this is the competitive equilibrium price for cloth. It is here that the philosophers and broad brush painters are separated out from the operations researchers, engineers and experimental gamers. The former inspired by painting a broad picture of the price system leave the details of its emergence to those with possibly lesser imagination. The others worry about the details of: "How do goods get from here to there?"

Few or Many Markets?

Before we tackle looking at any market mechanisms, we need to think about how to define what is meant by a market and consider how many markets are needed to promote efficient trade. At its simplest we may regard a market as some form of network of traders or a magic black box where some traders bring amounts of commodity A and offer to exchange it for commodity B. It is distinguished from barter in two ways. Barter was not designed to accommodate a large number of traders essentially simultaneously and anonymously. Markets evolved to do this. Furthermore as is noted below, not only did markets evolve but they were accompanied with the evolution of a special commodity called money. One of the crowning moments in teaching about money is to show how in an economy with only 100 commodities for exchange, where there is a market for any pair of commodities the number of markets will be 4,950 allowing every commodity to trade directly for every other commodity. If instead, society selected a special single commodity to always use in trade for any other commodity all members of the economy could get along using only 99 markets. This reduction is achieved by all participants being willing to exchange baked beans for books indirectly by selling the baked beans (or one's labor) for money and using the money to buy books. It can be shown completely generally and rigorously that with many products and services in everyday life markets and then money will emerge as the way to trade (Dubey–Sahi–Shubik, 2014, 2015).

It has been suggested that a picture is worth a thousand words. An example in support of this is given in the simple picture in Figures 5.1a and 5.1b below. The first shows a complete set of ten markets, where each node 1, 2, 3, 4, 5 is labeled with one commodity. Each arc represents a market between two goods, for example the arc (1,3) represents a market between goods 1 and 3. We observe that the role of every commodity is intrinsically symmetric when every two good or binary market is available. In Figure 5.1b the five commodities are still there, but the number of

markets has been reduced to 4. They are (1,2), (1,3), (1,4), and (1,5). The first commodity has been selected to play a special role. It has become a commodity money. If someone wishes to trade good 2 for good 4 this can no longer be done directly but 2 is first traded for 1 and the amount of 1 received is used to buy 4.

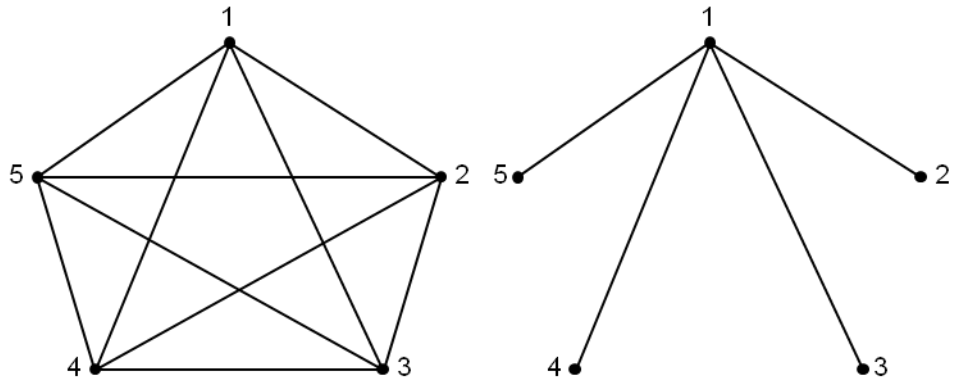


Figure 5. (a) Markets and (b) Money

The model is intrinsically nonsymmetric. Good 1 plays a special role. We could have equally well selected any one of the 5 goods to be the money.

On Process Models and the Gaming Test

> This is not a game, but a training for war!
> — Comment on Kriegsspiel of von Reiswitz[14]

The profession of operations research is a mixture of engineering, practical behavioral observation and economics. It deals with explicit processes and the explicit mechanisms that enable a good, service or an individual to proceed from point A and arrive at point B in good condition. In some sense it deals with the small picture. But the many small pictures it deals with when all brought together, provide the mainly unseen technical structure for the running of the many networks that make up a complex society. They include the scheduling of air flights, the delivery of food, electricity, water, heat and health services.

The occupation of experimental gaming is allied to operations research in its concern with process, but it is also related with economic theory, in the sense that the experimenter builds models that are meant to represent some economic phenomenon such as a stock market and enables a number of individuals (often undergraduate students) to play an active role in the markets and then studies the resultant behavior to see if it conforms with the behavior predicted by the theory.

In studying human behavior it is not easy to design precise experiments; unlike in elementary physics where one can have even high school students run and understand controlled experiments, it is very difficult to achieve the same sort of precision for human subjects. A major

reason for this is that we are not all fungible atoms; we each come to an experiment as an individual with his or her value systems, personal memories and experiences. Furthermore an experiment in a gaming laboratory trying to predict competitive behavior among make-belief firms in a simulated environment has to completely distort the role of time. Several years of competition may be meant to be covered in an experiment that lasts only an hour or two. In spite of the limits noted above experimental gaming has enormous advantages both in reality training and in stretching the imagination. By the very act of having the game played, it has to be "debugged," in other words, any errors in logic or omissions are soon found out by the players who either complain to the designers or take advantage of them in the game. One example that comes to mind from designing war games is to make sure that production processes are not reversible. It may be that 10 tons of steel and 20 hours of factory time are required to produce 1 tank; but that does not imply that it takes 1 tank and 20 hours of factory time to produce 10 tons of steel. If the model does not forbid this explicitly some high IQ mathematician will reduce the game to a parody by winning a war by using tanks to overcome a critical steel shortage in a way that is physically impossible in reality.

Experimental gaming in the social sciences has its roots in a far earlier history of operational war gaming in the military (Brewer–Shubik, 1979) where the use of the war game is to construct a model of a potential conflict that not only provides good physical descriptions of the environment, but permits the players to test out different strategies. It is fairly obvious that there is an impossibly large number of moves and countermoves that could be considered, but in practice human organizations do not consider more than a few, strategic plans where "few" is usually a number between 2 and 10. Not only are there a few plans that can be tested, the military has long recognized that although some features of an operational game can be quantified (such as the firing power, range, and accuracy of most weapons), not only are many features of a battle qualitative but are highly uncertain. The war gamers have treated the difficulties in trying to understand the qualitative and uncertain by introducing the referees as a participating part of a war game. The game may be stopped at any time when the players and referees together decide on whether a particular move or action is plausible and has the effect suggested by the referees. This whole process is designed to utilize the game as a clarifying and measuring device that produces a better process model of some relevant part of reality.

Both the construction and playing of an operational game stretches the imagination. The writing of plausible scenarios of, say a future war in the Middle East requires not merely many facts but a qualitative description that may be provided by the abilities of good military historians. It is a challenge to the practicing economist to consider how to write a politico-economic "war game" to study a potential future economic depression. Some operational politico-economic gaming, though not as precise as experimental gaming, might be of use in both practice and in the development of theory.

The world is full of businessmen, journalists and economic experts who are wonderfully imaginative after the fact. They are able to explain yesterday's crisis in many thought provoking different ways. Unfortunately the knowledge of outcome does not confer an understanding of the process on the viewer. Yesterday is still rather difficult to postdict, but it is easier than predicting

tomorrow and either provides a living for the Wall Street Journal, The Economist and others of the financial press. The public loves predictions, and fortunately its memory is bad, hence the wonderful new way to predict markets today is fodder for the current press until it fails in a spectacular manner. In several years' time after the failure it can come back onto the cover of the then current manifestation of a Fortune Magazine as wonderful new way to predict markets.

Market Mechanisms and Minimal Institutions

We only need to look at a simple model of exchange to see the enormous distance between theory and actuality in economic theorizing. In the discussion above it has already been noted that the general equilibrium model of the economy is devoid of markets and money. In order to connect this work to the dynamics of the economic world we know markets and money must be introduced in a manner that enlarges the mathematical structure of general equilibrium to accommodate process. It is easy to make this verbal statement, but the actual construction of an appropriate mathematical model to do so has eluded the profession for many years. Along with several other mathematical economists, I had tried, but failed to produce a decent model. Someone more interested in macroeconomics such as Donald Patinkin (1922-1995) a Chicago Phd who migrated to Israel and served for several years as president of the Hebrew University also tried. He wrote an important book entitled *Money, Interest, and Prices* (1956) that was hoped to be a microeconomic explanation of the work of Keynes macroeconomics. Unfortunately although initially hailed its explanations did not hold.

A successful microeconomic model was built in a completely unexpected way. The model was built by considering the problem from the viewpoint of elementary physics. In late 1970, early 1971 I was working with my colleague Lloyd Shapley on several basic problems linking the solution concepts of a part of game theory known as cooperative game theory. Two contrasting branches of game theory have been cooperative game theory, primarily sponsored and developed by von Neumann, Morgenstern and Shapley and noncooperative game theory advocated by Nash. Both of these highly different approaches had their historical basis in the work of Edgeworth and Cournot (1971).

Cooperative game theory was based on the ideas of both von Neumann and Morgenstern that individuals were social animals, and if it was not prohibitively expensive they would talk with each other and try to work out deals that would make the economic pie as large as possible, utilizing their powers as individuals and bargaining groups to stake their claims to as large a piece of the pie that met some criterion of being reasonable. The technical details on what could be defined as reasonable conditions are given elsewhere (Shubik, 1982) and lead us into the details of how to characterize fair division and what constitutes a reasonable bargaining threat by one group against another. The reader interested in seeing these details can go to the reference given or to the many other texts that cover cooperative game theory. Shapley and I in our concern with linking cooperative game theory with the economics of an exchange economy had an important basic question that we wanted to answer. There are several different cooperative game solutions. How to they relate with the competitive equilibrium in an exchange economy?

There is a solution (called the core dealing with collective bargaining) that is primarily

concerned with the power of all subgroups in an economy; there is another solution (called the Shapley value) dealing with the construction of an appropriately weighted average value over all possible coalitions that meet conditions of fairness and equal treatment conditions in joining coalitions. There are also several other quite complex solution ideas involving various bargaining conditions. If one models an exchange economy as a cooperative game with only a few players, then each of these different cooperative game solutions picks out a different set of outcomes. Suppose that we were to consider a large number of agents, what would happen? There is a fairly easy simplistic mathematical way of doing this. It is called replication and was, in one instance already utilized by Edgeworth (1881). Under replication whatever the numbers of butchers, bakers or candlestick makers there are, we replace them by *k* times as many and then let the *k* become very large. The question now becomes how do each of the different cooperative solutions behave? The answer turned out to be somewhat surprising to us. The main cooperative solutions keep changing shape and ultimately converge to the competitive equilibrium outcomes of the exchange economy. We had shown that the competitive equilibrium had properties far beyond just being an efficient price system.

On reviewing our work we realized that although we had examined the limiting properties of the cooperative solutions we had not considered the noncooperative solution whi[15]ch was sociologically different. Furthermore, I knew that Cournot y in 1838 had already demonstrated that the noncooperative equilibrium price converges to the competitive equilibrium, in a special simple one good market model where many buyers using money face two, then progressively more firms selling the same commodity (Cournot, 1971).

The European or the American Way?

Before specifying how to link the Cournot–Nash noncooperative equilibrium theory to the work in general equilibrium and to money, two personal talks that I had with von Neumann and Nash merit noting. It was a rare privilege to talk with von Neumann at any length, but on one occasion, talking on the train from New York to Princeton we discussed the concepts of cooperative and noncooperative solutions to a game of strategy. He was adamantly opposed to the general use of the Cournot–Nash noncooperative equilibrium as it was so asocial that it ignored the rest of the society. Besides that he added that at this stage in any attempt to mathematize theory in the social sciences one should avoid theories that were too specific in their predictions. In general, at best one could hope for a theory that narrowed down the possibilities to some set of outcomes. The reason was that the mathematical abstraction would have ignored many of the institutional details needed for a precise prediction. A little later when I had a chance to talk with John Nash and tell him of von Neumann's comments, John's answer was that this did not surprise him because von Neumann was a European who thought in collectivist and cooperative terms, but did not understand the real American way of individualistic behavior.

Nash's early basic papers applied to economics were elegant and profound, but then and for the rest of his life he never gave any signal that he was able to appreciate or understand the limits, difficulties and problems in applying mathematical models, while taking into account the appropriate context. This contrasts with both von Neumann and Shapley who were both sensitive

to the importance of context in models involving human behavior.

On to a Price Forming Game

In December 1970, I had been working unsuccessfully for around ten years on trying to build a mathematical model that would clearly reintroduce money into the ADM mathematical model of the Walrasian system. I decided that after around a decade filled with butchered models that led nowhere it was about time to give up and move on to other less daunting problems. Out of a sense of completeness concerning the work with Shapley I felt that if we could get a decent mathematical model that was able to show the convergence of the noncooperative equilibrium to the competitive equilibrium in an exchange economy we would have a powerful story to support the emergence and use of the price system from many points of view. It would appear that from virtually any political and social point of view, when one can use it, the price system has many virtues.

It is highly worthwhile knowing that these abstract models tell us that the price system, when there are many individuals in all markets, appears to meet several criteria, not just tests of efficiency.[16] The price system can be interpreted as an outcome based on competition among many individuals (in which instance there are coordination problems) or it can be interpreted as arising from a centrally coordinated calculation bureaucracy (giving rise to a horrendous problem with information and incentives among bureaucrats and politicians); or it can be interpreted as arising from threats and counter-threats by subgroups.

Unfortunately the CE is not unique and the different efficient prices distribute wealth in different ways, so that even at this level without some further social decisions there is no magic “perfectly fair for all” unique CE.

A World of Monopolies

Fame in economics, like every other aspect of human life is a fleeting event for all but the top few. The very nature of life and scholarship is that the lesser scribblings of yesterday be quickly turned into loam to help in the growing of the new crop. So it is with those who lived in the interesting times from around 1890 to 1960 when the maps of Europe and much of the world were being redrawn at a cost of much turmoil, social upheaval and millions of lives. In England and the Americas many talented Europeans who had escaped with their lives as well as the local scholars were expressing views that stretched from the far left to the far right. Schumpeter’s (1950) *Capitalism, Socialism and Democracy* warned of the choices; Hayek (1944) in his *The Road to Serfdom* described the slippery slope of socialism down to the destruction of a free society. In the middle and the middle left were a variety of Keynesians and on the left and far left were many individuals notably at The London School of Economics associated with the Fabian Society with socialists such as Harold Laski and G. D. H. Cole, and at Cambridge where there were dedicated Stalinist sympathizers including Joan Vera Robinson (1903–1983) who was probably the leading female economist of her time. Many of those on the left did not see the

nightmare of the Soviet Union, for what it was. Most of the European expatriates on the right were deeply sensitized and equated the Nazis and Communists as the same evil. Most of the names noted above have disappeared from modern sight, except for historians of the social sciences.

John Robinson still can be seen along with E. H. Chamberlin as economists of the second tier. She wrote a book on monopolistic competition that was a competitor to the one written by E. H Chamberlin at Harvard. Although I learned far more from the latter, the title to her book intrigued me, and when I read it I perceived that she had tried, but failed to produce a rigorous model of competition where every firm was a monopolist.

When I turned to trying to produce a rigorous mathematical model for the Cournot–Nash equilibrium I decided that an appropriate plan of attack might use the simplification suggested by the title to her book,[17] then replicate all firms and replace the economy with a group of duopolists, or two firms in each industry and then continue to replicate the model until there were many firms in all industries.

The simplest way to form prices. This approach was already given implicitly by Cournot and Walras. Price may be regarded as the exchange ratio between the offerings to exchange two goods. If the market as a whole has traded 24,000 bananas for 12,000 oranges the price of bananas in terms of oranges is 1/2, or the price of oranges in terms of bananas is 2. If all goods trade directly for each other then there is no reason why one should care whether you quote prices in terms of bananas or oranges. Price is merely an exchange ratio. As is noted below; but when we introduce the concept of a money, there is a strategic difference.

On the virtue of an assumption of symmetry. It is often the case that by invoking various aspects of symmetry, such as assuming that all individuals have the same strategic role in trade, one can construct a simple, but good enough model to analyze the problem at hand. The question that I posed to myself was to see if an intrinsically symmetric playable game that formed price could always be built where a simple independent simultaneous move by each trader could lead to the formation of efficient market prices. Consider the simple case where the number of trader types and goods are the same and each trader holds only one good. The answer is yes, an intrinsically symmetric playable game can be constructed if there are complete markets and no if trade uses a single money.

A basic and probably **the most important property of a money it that it can be used immediately to buy any marketable good or service** in the economy. This means as was shown above that there exists a market between the money and every other commodity. It is completely liquid. In a monetary economy oranges do not buy apples, they are sold for money that, in turn can buy apples.

A problem with liquidity.

> In God we trust, all others pay cash!
> — Old American saying

In building a playable game with monopolistic competition a practical problem appears that faces every individual and business in an actual economy using a price system. When you sell an item do you immediately get the use of the resources you received to pay for something else or do you find that you have to wait for some time before they become available? The common use of the word **liquidity** is as a measure of how quickly a good can be turned into cash at or nearly at the last market price. It is hard to turn that into a precise measure; but one can say that an item is completely liquid if it can be used immediately to pay for any purchase, in other words it is a money.

There could be more than one money. It is possible (but unlikely) that every commodity is a money, in which case the economy has complete markets, any commodity can exchange directly for any other commodity.

Suppose that there are 5 types of traders and 5 types of goods where the initial amount of any single good is held by one type of trader who holds nothing else. Can we devise a simple trading game that lets them achieve efficient trade in one move where the role of each trader is intrinsically symmetric? It is here that a distinction becomes critical. We can build two different models of a trading structure, the first with 10 markets as was shown in Figure 5.1a and the second with 4 markets as was shown in Figure 5.1b.[18]

Model 1. Complete markets: In the first model that has 10 binary markets let us consider that Any trader whose name we call i uses as her strategy the offer to exchange some amount of her commodity i in all of the 4 markets where she would like to obtain quantities of the other commodities. Prices will be formed in every (i,j) market by taking the ratio of the amounts of commodities offered.[19]

Model 2. A single money: This model has only 4 markets and say, for example, that the commodity of the first player is the money used in this economy. The way the initial conditions have been set up with the distribution of the goods and the existence of only 4 markets we can no longer build an intrinsically symmetric game because one of the traders has become distinguished from the rest. He has become the holder of the one liquid asset in the game. The others cannot trade because they have no means of payment.

The actual design of the economy is reasonably parsimonious and we know from everyday life that it uses money and tries to keep the number of markets down to a minimum, so we need to ask what has happened in going from Model 1 to Model 2 and how can we get a monetary system that takes care of trade with only a few markets? A great economizing of the number of markets has been made, but in doing so we created in Model 2 a liquidity problem that did not exist in Model 1. In Model 1 the only constraints to trade were the individual trader's **total wealth**; in Model 2 trade is still limited by an individual's wealth, but now it is also limited by

his **cash flow constraints.** Even if she is wealthy in terms of her assets an individual may not have enough money to buy what she wants. Society cures this state in many ways, by having enough money well distributed, by having central clearinghouses, money lenders and various types of banks as well as government agencies provide for a variety of bridging loans and other forms of credit. In this chapter we do not deal with the many forms of credit possible but limit ourselves to commodity money and the money supply and close with fiat money and accounting money and the ideal clearinghouse. Comments on credit come later.

Enough money well distributed. It can be shown that there will be many exchange economies where it is possible that all individuals can start with enough money that cash flow constraints will not be binding and that at the end of trade the final endowments of money will be the money earned from sales minus the cash bids that they made. There will be noncooperative equilibrium solutions (NCEs) to these games that become arbitrarily close to the competitive equilibria of the General Equilibrium (GE) exchange model if there are many individuals. These are not the same as the GE model because they all have to satisfy cash flow constraints in a world that uses commodity money. This simple world does not have any loan markets. It is strictly cash-on-the-barrelhead for all trade.

Oligopoly or competition and price. The mathematical models with the Cournot price forming mechanism make precise the meaning of the role of many agents in competition. In the limit when there are many traders and all of them are small no single individual can influence the reigning market price.[20] When the market is fully competitive then, in essence, it no longer is represented by a game involving *n* individuals in direct competition with each other but it breaks into n two player games where each game is that of an isolated individual playing against a faceless mechanism called the market. Face to face human interaction has been removed. In such a situation the economics of perfectly competitive markets can best be called a **nonsocial** or **asocial science.** In actuality this limit is hardly, if ever, reached on both sides of any market. Someone is large enough to influence price. There are almost always some big fish in the pond.

Where Does the Gold Come From, and Who Controls the Supply?

The supply of gold in a single country comes from the mining industry or from foreign trade. If the country does not produce gold and has no financial sector all agents are intrinsically the same in regards to their role with money. If there is a mining sector then there is at least one set of agents who are distinguished. The miners are the manufacturers of money.[21]

An aside on a world with a pure gold standard. If the world were a single unified economy using gold as its currency with no credit then the only source for money would be the gold industry. Although the agents would not be symmetric in regards to their production of money; if there were a large number of competing gold miners and the production conditions were appropriately competitive markets could exist in this gold standard world with no central banks.

A consideration of this model immediately highlights one of the central paradoxes of monetary theory, **a commodity money has two alternative uses, its' services can be used in exchange or in consumption (or production), but it cannot be used in both simultaneously.** A

commodity money such as gold is a consumer durable. It is meant to be a store of value, which means that the asset (like any other durable) has a value in the next period, but how do we evaluate its future worth? Do we take the discounted value of its services in exchange or in consumption? In equilibrium we can argue that the marginal values of the gold in exchange and in consumption should be the same thus the valuation will be the same. Either way we are saying that the store of value aspects of gold are based on **the expectations of what it is worth tomorrow.** This depends primarily on the needs of trade and the future demand for jewelry and a few manufacturing processes that require gold.

It appears to be that the technology for producing gold is such that we cannot economically mine enough gold to meet the requirements of growing trade without prices sinking relative to gold. The inflexibility and expense of trying to expand the gold supply sufficiently given the marginal cost of mining rules it out.

A playable game. The number of models of a playable game representing a market as a game of strategy, like the Hydra with more heads sprouting for every one cut off, show a proliferation of special institutions, each with one or more economic functions. We call the process models Strategic Market Games (SMG for short). Is there a unique process oriented representation of an underlying Arrow, Debreu, and McKenzie (ADM, for short) exchange economy? The answer is no. There are several basic representations because the carriers of process require more detail than does the static economy. Is the amount of money required to run a strategic representation of the price system fixed? Again the answer is no. There is a different SMG for every price formation mechanism; and each will generally be sensitive to the initial conditions. At best, a theorist can only make general statements about the largest and smallest amounts of money needed in order to satisfy the cash flow constraints they impose on trade.

A process model has been described that permits efficient trade using a commodity money. Forgetting the practical warning on the mounting costs of gold mining, we could imagine that the commodity chosen for the money is gold. It has been a popular choice as a money for around 2,500 years. As the English economist William Stanley Jevons (1835–1882) (1879) noted there are many specific properties that determine the selection of a commodity to act as a money. These include the costs of how it can be produced, its durability, portability, cognizability and other detailed functions such as its alternative uses in production or consumption. Historically gold, silver, copper, and barley, have been used as a means of payment with government emerging as the arbiter and enforcer of standards on quality with the formal emergence of coinage in Lydia (now in Turkey) and probably independently in China (Rubelis, 2013; Peng, 1994).

In the exchange model described above we have not dealt with the existence of fiat money or debt. The reason for staying away from doing so has been to stay as close as is possible to illustrating an economy where government has a minor policing role. Gold as a money does a reasonably good job of policing itself.[22] Even so the standards of minting, tests for quality and penalties for debasement and forgery need an overseeing quality control measurement and enforcement agency. Historically enforcement has required government action.

An Economy with Fiat Money

The difference between fiat money and a gold standard economy physically is that fiat money is **a virtual commodity.** When we add up the holdings of all individuals the amount of fiat we get is some positive number like when counting gold or bacon. Because we are free to pick a scale we can make its unit as small or large as we want in terms of its purchasing power. A competitive market may determine the exchange rate among all of the goods for sale, but the fiat that has now displaced whatever commodity money that was in use so that if in the previous economy there were n commodities, one of which served as a money, in the new economy there are $n + 1$ commodities where all real commodities play a symmetric role and the synthetic or fiat money is of no intrinsic consumption worth but has value in being used for transactions purposes.

In the development of monetary theory a battle has raged over several centuries as to what backs a fiat currency. Why should any free individual in her right mind accept a worthless piece of paper in exchange for valuable goods? The two apparently opposed schools of thought are described as those who suggest that **the dynamics of expectations** make this possible; and in contrast, those who believe that it is the power and **coercive enforcement of government** that make it possible. It is argued here that both are right and the value of the money is supported by a logically sound intermix of both.

A highly desirable feature of an economy that uses government printed paper money instead of gold is that it has economized by releasing all of the gold tied up for transactions to be used for consumption or production processes and any way one wants to look at that, it is of economic benefit to the society as a whole.

The offsetting factor can, as was observed by the eminent British economist David Ricardo (1772–1823) be stated this way, “What do you prefer to trust, gold or a group of politicians?”

Who gets to control the money supply? A central bank or the gold mining industry? Nature and monopolistic competition bound the first, but the printing press and the monopoly control of a central bank pressured by the politicians and indirectly by public opinion bounds the second. In either instance it is possible to construct good mathematical models that show that from the viewpoint of straightforward but boring and unglamorous technical economics either economy is feasible (even taking into account the cost of printing and distributing government banknotes), but the fiat money model is more flexible and consumes less resources. Grand theorists be they Marx, Hayek, Schumpeter, or others can add a mix of the sociology, social psychology and politics that they either believe in or claim to be able to see in their crystal ball as to how the economy interacts with society as a whole. But mathematical economists trying to build a scientific base under economics and finance have to try to sift through the many factors that separate out the economic content of their models from broader context that surround them.

In this and the previous chapter the message is simple. Even with toy models, markets and money are emergent properties of any economy. In one form or another, the dynamics will produce them.

Considering the pressures of time and space in dealing with mass markets and varying levels of trade a symbolic money is economically superior to a commodity money. But a symbolic money opens up horrendous societal problems to which there is no single scientific solution. If the central government controls the money supply it has been presented with enormous power over the economy. It opens the path for administratively easy ways to tax and subsidize its citizens. The old problem of: Who guards the guardians? appears, and in practice at this time the debate rages on in the form of deep arguments on how much political independence should a central bank have. It is also reflected in discussions concerning how to distinguish monetary and fiscal policies, with at least one argument suggesting that a central bank should be concerned with managing the money supply and some interest rates and little else. Fiscal policy, in contrast is the use by the government of its revenues in order to influence the economy for politically determined social purposes. Even though monetary and fiscal policies are often highly closely intertwined there may be societal safety in keeping their controlling groups apart.

Paper Money for Everyone?

If a society is going to have a symbolic money why not have everyone issue their own paper money? This would give us a world where each individual is his own banker. This possibility not only is logically feasible and can be demonstrated in a mathematical model, but it is possible to build an experimental game that illustrates the conditions under which it will and will not work. It works when there is a perfect central clearinghouse available that takes in all the bids and offers for everyone who offers goods for sale in the markets and bids for all goods utilizing his own currency. The perfect clearinghouse then solves a simple set of equations to determine the exchange rates that clear all markets among all of the personal currencies This involves no extension of credit whatsoever. This is as though there is a perfect balance of flexible international trade currencies. In a laboratory with around 20 business school students it is fairly easy to have them all seated in front of their own computer console where all are connected to a central clearing and computational mechanism. Even with this set up a trader could offer for sale goods she does not have, hence the system has to include **failure to deliver** rules that notify the central agency if goods are not delivered and it has to be able to enforce penalties high enough to prevent this.

As with any other, even mildly complex system when one tries to construct an operating system that can handle the dynamics the details pour in. The purely market economic problem has to be supplemented with the systems design problem of devising the rules to keep the game honest. Modern economics has made some headway on this problem considering different levels of information, incentive systems and contract theory; but as with any broad investigation of human behavior there are games within games required to provide the rules and laws for the functioning of markets. Details are boring, but a good sales pitch can be fun and the snake oil or elixir of love salesman gives his targets the enormous jolt of hope with his vision of instant gratification and no footnotes whatsoever to read. After the snake oil has been sold, the multiple hidden charges paid for or the vote has been taken the gullible will have all the time they need to adjust to being worse off than they were before. Dull detail goes with the turf. It is a dreadful necessity for any well run state.

On Socialism, Capitalism and Democracy

> Under capitalism man exploits man; under socialism the reverse is true.
> — A post WW II Polish proverb

Many West European and American economists have thundered against socialism as the shibboleth of free enterprise; while others have inveighed against the selfishness of capitalism. It is always handy to have a whipping boy available and depending on one's tastes one can set up for this purpose the wicked commissars, central planners and apparatchiks or greed crazed billionaires and the jackal politicians they have bought to help to carry out their exploitation. Although this serves as a splendid outlet for purple prose and a call to the barricades and the boardrooms, unfortunately as the scientific method and mathematical models inch their way into economics and the social sciences certain words that serve as the focal point in the rhetoric turn out to be without sufficiently clear definition under analysis. Thus the words capitalism, socialism and democracy go from a malevolent or beneficent precision as rallying calls to a haze of unspecified meaning when one attempts to build formal models. The good formal modeler rather than regarding them as symbols for the Devil or all things good and beautiful, if he needs to define them, gives them an explicit definition in the form of an *ad hoc* clean limited label that hopefully is good enough to help to answer the questions the researcher has posed.

In the books and articles on which these essays are based, to a good first approximation, an ideal capitalist economy is one where directly or indirectly private citizens own and operate all of the means of production and prices are not directly set by the government. A socialist economy is one where government owns and operates industries that could be privatized. A full polarization of the concepts would require stress on what is meant by all the means of production. There is no such thing as a purely capitalist or socialist economy. Reality lies in between. Even all states labeled capitalist have a nationally owned judicial system (although buying judges may be an active pastime, it is illegal).

This leaves us with the task of trying to define democracy. When we need to answer a question that depends on our need to define terms such as freedom, democracy, fairness we find that we have considerable leeway. We are not going to launch into an exegesis here but note that the origin of the word democracy has as the first part the Greek Demos or common people. Operationally it means that in some way or another all citizens have some form of direct or indirect control over the government. A common, but by no means the only way is the vote. Being a democracy does not necessarily imply a single vote for each of its citizens. In Great Britain in the 1930s some individuals in London had more than one vote, one general, one business in the "city" and one university constituency vote. In some countries the prison population has no vote.

The great French philosopher and mathematician Nicolas de Condoret (1743-1794) who was killed in the French Revolution at the age of 50; showed that there were logical problems with using simple majority voting. He posed a simple example where if three voters have to choose by simple majority rule among three candidates the voters could have different preferences in lining up most preferred, second preferred and least preferred in such a way that whoever is

chosen as a winner there would always be two out of three voters who prefer other candidates[23] In other words if the candidate were Andy, Bob and Claire and the choice were Andy or Bob, Andy loses 2:1 to Bob; Bob or Claire, A, Bob loses 2:1 to Claire; Claire or Andy, Claire loses 2:1 to Andy. This is called the Condorcet Paradox.

Kenneth Arrow, expanded the basic observation of Condorcet to show that if individuals in a society could order their individual preferences over any set of items such as candidates or referendums there is no method of social choice that would guarantee that a society as a whole could rank its social preferences and satisfy reasonable conditions that each individual has some strategic power in determining the social choice.

There are many mathematical political science studies that have shown various logical problems posed by the simple majority vote and other voting procedures such as super majority requirements in the Senate or indirect election of the prime minister in England. Recently it has been proposed that the voting procedure should be abandoned and replaced with a grading system whether one assigns a number such as 1–10 to all candidates and the winner is the one who has the highest overall approval rating (Balinski and Laraki, 2011). This introduces a measure of the intensity of individual valuations of the candidates.

For a vote to be democratically plausible one needs at least two parties. A one party totalitarian state may still hold a vote to make sure that **Big Brother** has enough clout to get all voters to the polls if they wish to stay alive. We note that in such states a coup d'état or war or internal decay of critical power centers eventually brings the end. Thus Hitler's Thousand Year Reich lasted 1933 to 1945, while the Soviet Union did somewhat better lasting from 1922 to 1991

For most of our purposes in studying formal economic models the crude definition of a democracy as a form of government where every member of the electorate has a choice that influences who will form a government is generally sufficient.

Under these crude definitions above the Scandinavian countries qualify as democracies that are more or less capitalist with a socialist tinge. Hitler's Reich was in part a capitalist totalitarian state and today's China is a part capitalist totalitarian state.

The physical facts are such that in a complex economy and polity a slogan such as "freedom to choose" becomes very hard to nail down. The concept of "I own an orange" differs from "I own a call on a share in a holding company that holds a majority of the stock of The Universal Bank Holding Trust"; this in turn differs from the fanciful statement that, I as an American citizen own a prorated part of the assets of the United States of America. Freedom of choice by an individual in a complex society is freedom to buy and sell direct possessions combined with freedom to buy or sell, vote or otherwise have some influence on **the managers of jointly-owned property**. The nature of the **fiduciary responsibility** attached to the delegated rights may vary considerably.

Freedom of economic choice may or may not be compatible with lack of freedom in some aspects of political choice. This does not appear to be a yes/no question. The answer appears to be on a continuum. This is not a "cop out," but it is an unfortunate fact of life that often complex

items are complex and the catharsis of rhetorical oversimplification does not make it go away. It does, however offer opportunity for silver tongued or ranting political hucksters to distort or even destroy a democratic system.

Political Economy is a complicated subject and the debate between normative and positive or purely empirical views of what constitutes a useful description will continue. The basic thesis here is that there is indeed a fundamental abstract economic theory that is worth developing and analyzing; but the gap between the theory and application can only be closed by the introduction of the appropriate details concerning both relevant specific structure and behavior in order to address the *specific* questions being asked in order to make application worthwhile.

Chapter 6

Process and New Formal Institutional Economics

In the previous chapter we discussed a cash only world with processes run with fiat money, gold or accounting money and a central clearinghouse covering transactions starts to illustrate the institutional arrangements needed in a financial system designed to support mass trade. It represents only the first trickle from the floodgates that have been opened. Even without considering chance, the logic of freedom of choice and economic efficiency provide reasons for the introduction of credit and a host of different ways to do so. Before asking and answering a simple basic question concerning the existence of fiat money we need to consider a preliminary feature involving time, expectations and durable assets.

Time, Expectations, and Durable Assets

When the mathematical economist deals in the purely static equilibrium model of the price system motion is ignored, it is a model where all decisions can be regarded as being made at one time and there is no need to worry about the operational differences between perishables and durables. The pricing of a ham sandwich and a steel plant present no basic differences in a perfect GE model. As soon as we insist on considering time and non-equilibrium states with at least one durable, where by durable we mean some item that lasts for at least two of whatever time periods we have chosen, we are forced to consider models with at least three time periods of economic analysis... There is no mystery about this choice; the minimal model with three periods has Yesterday or history, today or now, and tomorrow or the future. The economic agents only take actions today. They may **condition their actions on yesterday**, but those actions have already been made. They can also condition their actions on what are their **expectations** about what will happen tomorrow. How expectations are formed is what short and long term planning is all about and there is no single dominant theory. The experimental game experimenter has an opportunity to rig expectations by telling the players what left over durables will be worth to the players after the game has ended and accounts are being settled. With this information given we are in a position to consider where fiat money comes from and where it goes after the experimental game is over.

Is Fiat Money Debt?

Is fiat money debt? The simple **answer is no;** but the mystique of the central bank and high finance fools most of the people most of the time into believing the fiction that it is. In order to build a playable game utilizing fiat money in the laboratory, the experimenter who is out of the direct game, but supervising and influencing it may be regarded as the equivalent of the government and manages the money supply to the actual players from the outside. There are several ways the experimenter can take care of the supply.

The historical fix. We assume that there is an initial distribution of fiat money coming in from history. How it got there in the first place is of little interest as it is an individually owned

personal asset. The key factors are that it is recognized as legal tender today and that the individuals all expect that it will be of some value tomorrow. In the experimental games, at the end of the experiment we have paid the students a certain amount of U.S. Dollars (or Austrian Schillings) for any game money they have left over, so they know ahead what to expect.

If we examine the dollar bill over the last 100 years we find that the writing on the bill has changed. It currently says "This note is legal tender for all debts, public and private"; it makes no mention of the note being a debt of the government to the holder. Previously both gold and silver certificates existed. These stated that the U.S. government would pay the bearer, upon presentation, with a certain amount of gold or silver. In 1957 it was still possible to go into a commercial bank in New York with a silver certificate and ask for and receive payment in silver dollars. More recently, after all gold and silver certificates were withdrawn, on occasion the New Yorker magazine would send its man to the bank with a dollar bill to present it for payment by the U.S. government and receive in return a new dollar bill.

The interest rate fix.

> Drive for show, but putt for dough.
> — A golfing proverb

An experimental gamer can set up a somewhat different game than the above that introduces a money rate of interest. Suppose history still leaves the players with an initial supply of fiat. However at the start of the game the referee is willing to lend any player as much as she wants to borrow on the understanding that at the end of the game the referee is paid back the original amount borrowed plus any interest. This complicates matters because three new items have been introduced. They are: (1) a new financial instrument that we can call an individual debt contract or an IOU note that states that individual named *i* owes the government some amount of fiat money to be paid back at the end with some interest payment to be made; (2) the second is a fiat money rate of interest set by the government; and (3) the third is a default or bankruptcy rule that is imposed if the individual fails to pay back the referee.

Once more it can be shown that the miracle of competitive markets can produce competitive relative prices, but now both the price level and the distribution of resources are influenced by the initial distribution of money, the interest rate and the bankruptcy penalty.

The bankruptcy penalty, as history teaches us is not merely economic. In the good old days it could have involved indentured servitude, exile and debtors' prison, and currently the disgorging of real assets, the garnishing of one's income and more or less whatever the imagination of a creditor or debtor biased society can dream up.

The quotation at the start of this section reminds us of how quickly detail enters into the control of process.

The emergence of a money market. It is possible that an economy utilizing gold or fiat money as its money faces a situation where some individuals with plenty of assets have little money and the other individuals have plenty of money. Rather than borrow from the referee, or the central

bank, a money market could be introduced where the borrowers offer IOU notes and the lenders offer gold or fiat money and a market price can be formed that clears the money market. This determines a **market set money rate of interest**, as contrasted with the government specified one above.

A central bank and a money market. It is easy to propose more and more complicated market structures where each new market requires several months to analyze, as the control variables pile up or it has become so complicated that a computer simulation is required to get some insight as to how it works. This *caveat* or caution warns that any new institution or financial instrument that appears has to be considered from the viewpoint of what new function does it provide, and for whom? In the models above, as is often the case, in any complex economy, there may be some redundancy. Two different institutions may overlap in the performance of some functions, but they may still differ in other functions, thus a monopolistic central bank can both vary the overall money supply and influence its distribution; while a money market provides a competitive way to distribute the money supply. When both exist there will be a stress formed between the monopoly interest price fixed by the central banks and the competitive price fixed by the money market. How this stress is handled depends on specific extra institutional details.

The Concept of Mathematical Institutional Economics

We started with the shining ideal palace of a true believer in pure competition uninhibited by government institutions and were dazzled by the idea of the distribution of most goods and services via the markets. We observed that unfortunately the palace came without plumbing, wiring and other amenities. Our problem was to introduce the plumbing and other systems needed in order to make it livable without destroying the building. The method that has been used is to construct and analyze mechanisms in the form of playable games that carry out the functions needed.

Beginning with a simple exchange economy, as is given in abstract non-process mathematical economics models, it can be shown that with the presence of many individuals wishing to exchange many commodities with consideration for minimal complexity, in less fancy words: trying to keep things simple, it can be shown that

1) Markets and money emerge;
2) Being a money imposes extra conditions on any commodity;
3) The use of a money introduces cash flow constraints; and
4) Tight cash flow constraints can limit efficiency.

The cash flow constraints can be cured in several different ways involving new instruments and institutions. In particular:

1) By using gold as money, but mining costs and techniques may make it difficult to provide an adequate supply. How much gold as money is needed for efficiency? It depends on the transactions technology.

2) By constructing a central clearinghouse and using personal accounting monies **i**n theory this is doable but with considerable computational and coordination difficulties and it needs failure to deliver laws. As networking techniques improve special clearinghouses become practicable and transactions costs and time consumption become lower.

3) We may use a paper money for greater flexibility, but this requires the public trust of the political establishment.

4) With a paper money, even if the government is trusted new problems appear:
   a) How does fiat money get into and out of the economy? The fixes include subsidy, taxes and lending with a money rate of interest fixed by government; but any lending calls for bankruptcy laws to be specified,
   b) The existence of a national debt helps in the construction of a viable mechanism, it acts like a dam. A dam is able to store and release water strategically. A national debt can do the same for fiat money.
   c) The government can influence the amount and distribution of money; but the distribution could be achieved with a money market.

The listing above already covers a host of institutions without us having begun to discuss how to handle many time periods, uncertainty about the environment and any limits on human life, perceptions and behavior. The discussion has been limited to the physical features of mechanisms that carry process. As is noted below when we expand our scope to consider the other qualifications noted the number of institutions needed increases.

The existence of a Mathematical Institutional Economics occurs as soon as we try to operationalize the concept of economic process. We can easily talk about process in broad and oftentimes even grandiose terms, yet even when we consider the simplest construction of economic trade, institution after institution together with financial instruments and laws appear, not just as institutional special cases but as sufficient conditions to provide necessary functions. The fact that there may be more than one way to provide for a function is to be welcomed, it means that as in ecology there are many structures that at one level perform the same function, but that they differ at a finer level where they pick up different allied functions. For example, a bank note and a checking account balance of $100 both apparently have the property of instant purchasing power, however one can write a check for $23.58 with no difficulty, but one has to look for change for the $100 banknote.

In summary: The economic and financial institutions of an economy are the **carriers of process** and attach to the pure economy the interfacing connections to the society and polity within which it is embedded.

Chapter 7

Time and Institutions

Although Time Past, Time Present, and Time Future are enough to launch the first series of simple process models, they are not enough to show the deep change in basic view or paradigm shift that takes place when we start to understand the full implications of the games within the game, the economy, embedded in the polity and both encompassed by society set within the longer lasting powers of custom, religion and civilization.

We can consider a vast context and avoid draping the discourse too much in purple prose by noting just the essential differences in the time lags of political, legal, social and longer term value formation processes.

Although a real economy is not a one period experimental game, the basic logic of the more complex economy still has to cover the simple game, or anyone with any scientific pretense whatsoever needs to explain why this is not true. This observation leads us to be aware of another difficulty in mathematical modeling. We have represented the economy by a finite 3 period game. In an actual experiment the game may last for some finite number of periods such as 20 or 30; but in an actual functioning economy, except in rare cases such as a postwar reorganization of the economy of a defeated state, there is no clean, clear first or last period. Somehow or other we may need to consider if yesterday reflects all yesterdays and tomorrow is not simply the day of settlement, but it reflects that the economy might go on forever. How to deal with the infinite horizon has been a philosophical and empirical challenge to all of the social sciences as well as posing many mathematical problems.

There are many microeconomic problems that are close to engineering exercises, such as how to evaluate tradeoffs in design and location of a new factory or house, or how to minimize this year's tax bill. These can be viewed within the realms of engineering; but when macroeconomics and time periods of two or three years or more are involved the mathematical modeler has to openly label her atrocious oversimplifications, trying to keep a straight face while doing so. The unreality is enormous but many a Nobel prize winner in macroeconomics will argue that *ad hoc* modeling such as sticking in a magic growth level of say 3% per annum in productivity is a first step in clarifying what might happen on a "what if" basis in a growing society. The parable may be unsatisfactory, and is not as charismatic as Karl Marx or even Milton Friedman but it is a first step.

A more detailed approach in microeconomics is given by the seminal work on a mathematical model of economic growth of von Neumann followed by McKenzie and David Gale on multi-product, multi-period models. This has started to lay out formal structures, and raised questions concerning how to organize and gather data to match theory. Wassily Leontief attempted (not very successfully), to connect the theory to an empirical accounting structure in the light of economic statistics.

7.1. Rational Expectations and biting one's tail

Most of the models discussed in these chapters can be described as playable experimental games. In designing them to be played it is fairly obvious that they have to be played in a finite amount of time. We have already noted that one can take care of this problem by assigning to any game one extra period. This is the day of settlement where the referee attaches value to all left over assets. This is nothing more than a proxy for our expectations of what assets will be worth in the future.

In actuality, all of us very imperfect beings blunder around in foreseeing the future; then we rationalize our actions after seeing what has happened. If however we were true believers in either rational woman or rational man we could argue that no matter how long we wish to look into the future, if we are interested only in a dynamic equilibrium growth of the economy we can find some very elegant mathematics to support our ability to do so. I do not like dealing with infinite horizon models. Infinity is best left to the theologians, cosmologists and philosophers; however a good mathematical economist can produce a mathematical theorem that proves ideal competitive equilibrium growth conditions are logically possible for economies with an infinite horizon. The trick is to introduce what can be called `bite one's tail' expectations. This means that the expectations at the end are the same as the initial conditions of the economy changed only by a growth factor. The expectations problem is solved by guessing that self-consistent expectations exist and then proving mathematically that the assumption has been verified.[24] Unfortunately although this is comforting to know, very little is known about the ability of even this economy to regain its equilibrium if anyone makes an error, or it is otherwise not in equilibrium. In actuality we are always in disequilibrium and there is no error free system.

An aside on theory and proof in the behavioral sciences

> There are lies, damned lies and statistics.
> — Unattributed saying popularized by Mark Twain

Much of economic theory, mathematical economics and Game Theory is based on a statement of several assumptions (often formally called axioms), a statement of a proposition (such as supply equals demand at any price) and a proof that given the assumptions the proposition must be true. Given the assumptions the professional work reduces to pure mathematics and logic. The key problems in the behavioral sciences are in picking the assumptions and establishing that, at least to a good approximation, they are a decent representation of the phenomenon being investigated.

As any good lawyer, judge, politician, or scientist knows, it is extremely difficult to prove anything beyond a shadow of doubt. Any good debater knows when to risk bending or even inventing the facts in order to win the debate. Without an iota of cynicism it is safe to say that on almost any aspect of the political structure and the economy involving social values it is possible to assemble teams of first rate economists on either side. Charts and tables, complete with a sensitivity analysis to support the appropriate point of view can be made without violating the rules of scientific enquiry. They will be met by expert charts from the other side. Both in politics and in the behavioral sciences it is not merely what the numbers are, but what they mean.

Time and people. Before proceeding further we note the need to account for several features that have considerable influence on our understanding of the role of individuals in society and the economy. The type of agents described above implicitly live for the whole time of the game, but a simple check of records shows that all evidence indicates that no individual has ever managed to live for as much as 130 years, in spite of Methuselah's 969 years.

At best the ongoing role of ever-living economic individuals in an economy of indefinite length must be an allegory for a dynasty or a population as a whole. This obscures individual decisions concerning the passing of durable assets from generation to generation. This type of model leaves us our ability to talk about generations unborn but cannot be used to discuss any policy other than the immediately implicit feature that all generations are treated equally with no free will involved.

The concept of a dynasty model may seem to be an academic toy, but in some instances the fiction is real. The announcement on the death of an English monarch is: "The king is dead, long live the king!" This may have indicated not only that the reign of the monarchy is continuous and is not interrupted by death; but no inheritance taxes were due to the state.

It is a fact of life (and death) that individuals have only a highly limited lifetime when matched against the history of civilization of around 14,000 years. This in turn is brief against the around 160,000 (200,000?) years for *Homo sapiens* and then the 4.5 billion years for the Earth and around 14 billion years for the universe.

In spite of a quick academic look at ourselves as less than a flyspeck in biological time and even less in astronomical time we are more interested in putting tomorrow's dinner on the table than in the wonders of the universe, hence even 200 years is as close an approximation to infinity as most of us will ever need. Our individual concern for generations unborn attenuates within two or three generations.[25] For most natural persons and business and governmental institutions 10 years appear to be close to infinity. With civilizational problems such as climate change the short term view of the future could turn out to be a luxury our grandchildren can ill afford.

Two types of legal person. As society and the economy have become more complex the concept of a legal person has been enlarged to include both natural persons and corporate persons including ecclesiastical corporations, municipalities, other not-for-profit entities such as many universities, foundations and hospitals, and for profit corporations. All of them have the rights to sue and can be sued. Many of them have an indefinite lifetime. In the United States the distinctions between the rights of natural persons and corporations are still in flux, including problems such as distinctions concerning freedom of speech.

Overlapping generations

Over the last 70 years, starting with the French economist, Maurice Allais and Paul Samuelson, a large literature has grown in economics dealing with overlapping generations. Allais stressed the macroeconomics and government policy with money and financial institutions, Samuelson stressed the abstract mathematical structure noting the role of money as permitting individual

competition for resources while nevertheless transmitting resources from generation to generation even without direct inheritance.

Maurice Félix Charles Allais (1911 –9 2010) was a distinguished graduate of the École Polytechnique, a gushing spring in its pouring out of a large number of generally competent high level French bureaucrats. He was an important and long lived economist but somewhat minor Physics research hobbyist. As he wrote in French with little interest in being translated into English which since the 1930s has been the prime language used in economic theory, his impact on economics has been considerably less than his originality merited. In particular in his important book *Économie et Intérêt* (1947) written during the Second World War he hand computed and calculated motions in a macroeconomic model of the economy as a whole introducing the overlapping generations model, transactions structure, government control variables and growth in an example of over a hundred pages.

A simple diagram showing the generations together with government provides a useful intuitive picture of the game within the game. In Figure 7.1 government is represented as an infinite tape. In order to keep exposition simple individuals are considered only as young or old. The infinite staircase is built from a cascade of generations.

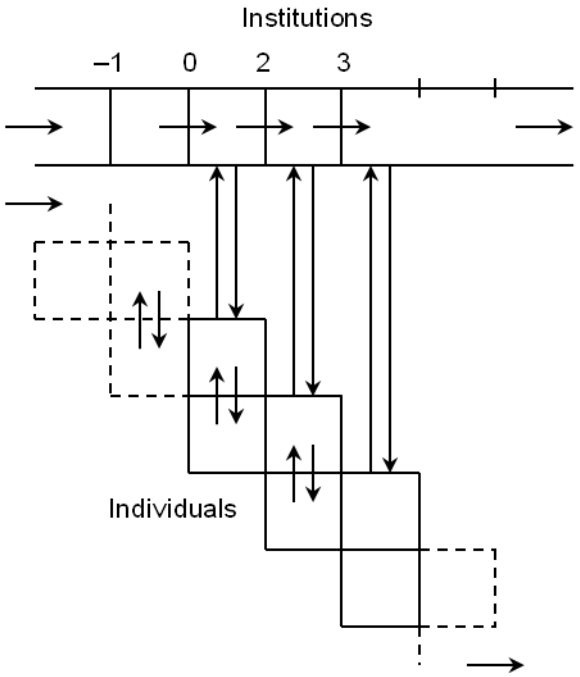


Figure 7.1. The game within the game

The infinite tape can be regarded as a catch-all for the full environment, including all institutions other than natural persons. The stairway that at every point is finite indicates the finite lives of the natural persons (we leave out the variability in life length, sex differentiation and the birth process as a first approximation), the arrows going up from the individual and down from the

environment represent the messages exchanged, including such items as votes, letters to the editor, calls for revolution, tax bills and taxes, conscription calls, birth certificates and passports, jail sentences and medals of honor. We may imagine a world where utterly individualistic agents are not interested in leaving an inheritance to their progeny, but are only concerned with maximizing their own welfare during their finite certain life times. They want to die broke. The mathematical model of Samuelson showed that under certain circumstances with no other public goods than money one could devise the libertarian's dream where the young are able to save sufficiently so that when they are old they have enough money to buy from the new young to consume in their nonproductive years and the new young earn enough from the old to be able to save enough to do likewise. Government is a passive shadow and the competitive price takes care of the economy. The proof that for some structures this is logically consistent adds to the power of the competitive model.

A society driven by its economy?

> The business of America is business
> — Calvin Coolidge

As is always the case logical proof in abstract theory does not necessarily mean feasible application to our society; but this possibility leads to another phenomenon of interest. This is the existence of an enormous class of societies with no particular communal, societal goal whatsoever whose engine is powered by the intertwining forces of cultural, religious, social, legal, and political behavior; but the direction of the society is moved by the reasonably well-defined local optimizing behavior of the economic agents who are willing to accept a large variety of environments.

The life cycle

Given that we can do a reasonably decent job of considering a macroeconomy with overlapping generations; it is reasonable to ask if there are important features in life that make it worth the effort to go for more detail. The MIT economist Franco Modigliani (a relative of the painter, but more conventional and less self-destructive) proposed that a life cycle view of the individual family could yield much information of direct economic use. In particular when population is not stationary there will be a bunching up of economic demands influenced by the age profile of the society. Societies with a large proportion of the young will see a surge in the need for education and housing; while those with an aging population may have more schools and houses than they need but fewer hospitals. One does not need to be a rocket scientist to see that the mere details of human biological growth and decline add a host of different time lags and complexity to both individual and social planning.

Society, and different time scales

We are now able to assemble a sufficiently detailed picture of the economy and its connection to the polity and society and even though we still have not discussed uncertainty explicitly, we have

enough pieces that we can put them together and observe that not only is the economy itself becoming increasingly complex but one overarching phenomenon emerges, that is almost all of the phenomena considered involve actions that take place on many different time scales. A good Frenchman used to buy his bread at least once a day, canned baked beans are probably not bought on average more than once every month, an employee of a large corporation may need to change residences once every two or three years. Criminal law may take decades to modify its procedures; the life cycle of the corporation, varies considerably from the human although both are legal persons. As the history of Stora Kopparberg with a charter from 1347 and merged in 1988 shows a commercial corporation can last to around two thirds of the age of Methuselah. Religious establishments do even better.

Staying only with economic and political processes and acknowledging that they all intertwine with different interacting time scales unless radical simplification are made such as those chosen by von Neumann and others already noted, the mathematics of what is known as multivariate nonlinear systems is such that the hope for a predictable dynamics is slender even without outside uncertainty.

An aside on fame

Astronomical and physical phenomena are good for billions of years; biological phenomena for millions. So far humanity has not yet broken two hundred thousand years and society barely fifteen thousand. The concept of fame seems to hardly have legs. The winning category appears to be religions and their founders who may have been mythical or historical figures, they so far have managed possibly four of five thousand years in the conscious minds of their followers thus Buddha, Confucius Moses, Jesus, and Mahomet are still around. Their temporal executive officers such as the popes help to preserve their names. The runners up for having their names engraved on history are mass murders and conquerors, thus we have Sargon, Ramesses the Great, Alexander the Great, Caesar, Qin Shi Huang, Genghis Kahn, Stalin and Hitler, to name a few.

Philosophers are possibly next in line with Aristotle, Socrates, and Confucius. Laozi, Sun Tzu, Mencius, Krishna, and Vyasa. To some extent they meld into the next category of identifiable mathematicians and physicists such as Pythagoras, Euclid Zeno, Archimedes. The other sciences and the arts are newcomers to individual identities. Music may have been around in one form or another for possibly 55,000 years, but the great composer is Anonymous and it was a tribal or cultural good until a few hundred years ago. In art and architecture it is difficult to find names before Phidias (circa 480-3 BC).

In our current world there are Emmy prizes, Oscar prizes, Nobel prizes, Abel prizes ad a vast array of medals, many of them with a pleasant package of goodies attached; but if fame is the goal a new religion or mass killings appear to offer the best routes to fame with legs.

An aside on profit maximization and rational behavior

The good micro-economist tries to squeeze the last drop of analysis out of profit maximization and so called individual rational economic behavior. For many problems these simplifications have paid off; but for many others such as understanding corporate bureaucracy and fiduciary behavior the direct profit maximization is not sufficient. Furthermore when the drama of innovation, the vagaries of the stock market and the uncertainties of the social and political environment are considered together, possibly a better description of the behavior the species *Homo economicus* is: Greed, modified by sloth, constrained by formless fear and justified ex post by rationalization.

The Basic Change in Paradigm

The critical formal decision model that bridges the spirit and content of competitive markets within society as a whole is the economy with many small agents with at least one large agent, the national government. Possibly one might advocate that in parts of Europe and America this was a reasonable model for some brief time around the early 20th century, but from the mid-19th century onwards the world has seen not merely a considerable rise in the world population but the growth of large business firms and the rise of the financial institutions needed to cope with increasingly complex financing brought on by mass markets and mammoth corporations.

Noted below, ranked by size of employment with employment and revenues given are tables for the 10 top nonfinancial corporations, 10 top financial institutions, and 10 top government bureaucracies

The 3.01 Bureaucracies

From the point of view of the major political and economic rhetoric in Europe and North America the right inveighs against the government bureaucracy but implicitly supports the corporate bureaucracy and the left wing does the reverse. Matters are a little more complex.

Currently there are three well-developed bureaucratic systems, and the glimmerings of a fourth, that exist in human societies. They are government bureaucracies, business bureaucracies, independent not-for-profit organization bureaucracies and the glimmerings of a world or international bureaucracy.

Government bureaucracies.

> One of the operating principles of authorities is that the possibility of error is simply not taken into account. This principle is justified by the excellence of the entire organization and is also necessary if matters are to be discharged with the utmost rapidity. So Sordini couldn’t inquire in other departments, besides those departments wouldn’t have answered, since they would have noticed right away that he was investigating the possibility of an error.
>
> — Franz Kafka, *The Castle*

The inveighing against both the size and inefficiency of the central government bureaucracy is a major sport for not merely the far and middle right, but even ordinary citizens of left wing persuasion when hounded in error by an unbending bureaucracy.

Viewing the sweep of history there is little choice other than bureaucracy in a highly populated city oriented civilization. The early forbearers of modern bureaucracy may be regarded as the Roman Empire (27 BC – 476 AD) and the Han dynasty in China (202 BC – 220 AD) both large and with populations of order of 50,000,000. The Roman Empire built roads and stressed both military accessibility and trade. It provided law and an integrated legal system with an apparently decentralized bureaucracy recruited locally.

In contrast the Han dynasty had an elaborate exam system heavily based on Confucian beliefs where recruitment was based on the recommendations of the aristocracy combined with a stultifying examination system.

Eighteenth century England and the Dutch republic saw the rise of a modern efficient bureaucracy; where, as was observed by Lord McCauley the bureaucracy was transformed from a set of "livings" bestowed on the clients and cronies of the aristocracy towards a meritocracy where a professional could be expected to stay in his position for many years and was expected to have substantive knowledge.

Apart from preventing the formation of a central bank, another populist act of President Andrew Jackson directed at the government of the United States was the institutionalization of patronage as a means to staff a bureaucracy. Under Washington there had been little need for a bureaucracy beyond State, Treasury and War. Even then a case could be made that patronage was the way these first positions were distributed. The expansion of the country both in occupied terrain and in population during the 19th century followed by the impetus of the Civil War and the industrial revolution called for considerable growth and patronage. After President Garfield's assassination by an individual who did not get his government job there was a reaction that led to a consideration of the need for a bureaucracy based on exams and competence. The great depression of the 1930s and the needs of administrators in World War II were a further source of growth. Government employment decreased considerably after World War II but has increased somewhat under both Republican and Democratic administrations since then. There are many definitions of what we might mean by a bureaucrat as contrasted with a government employee. For our purposes here as a crude index we utilize government non-military employees as an indicator of how big the central government sector is. However many are employed by the political subdivisions below the central government. In the United States these are state, city, town and village government units and other entities that have tax power to operate with other people's money. In the 1980s there were around 80,000 political subdivisions with the power to tax and this is still a reasonable order of magnitude.

In the Soviet Union, Nazi Germany and Maoist China membership in the party became a requirement for the top bureaucracy.

Interpreting these tables illustrates the problems involving concepts, correlations and causality.

The tables offer no more than a “sweetening of the intuition” concerning the numbers of individuals on the government payroll. For example that illustrates problems in interpretation when a modernizing country with a large peasant army starts to reduce the army considerably, this may be a sign of the expansion of military capabilities if a smaller, more highly trained and better equipped force is replacing the old force.

Table 7.2 shows the relative size of the nonmilitary bureaucracies to the full workforce in a few of the countries for which the information was available. It is based on a survey and study performed by the International Labor Office (ILO) in Geneva (Hammouya, 1999).

Not all of the government employees are bureaucrats, but even those who are far down the totem pole such as the village post office employees have **negative bureaucratic power** and know how to use it; for example, by withholding information on special deliveries and relishing queues of “summer folk” where the city dwellers in their second homes try to get services from the year-round locals.

Table 7.1. Government military employment size, 2013

Country	Population	Military
France	64.3	215
Germany	82.1	181
Russia	143	864
Sweden	9.7	20
Switzerland	8.1	23
U.K.	63.1	160
China	1385	2285
India	1252	1326
Indonesia	250	414
Japan	127	248
U.S.A.	320	1362
Brazil	200	318
Nigeria	173	80
South Africa	52.8	62
Egypt	82.1	439
Israel	82.1	439
Saudi Arabia	28.8	234

Note: Population in millions, Employees in thousands
Sources: Data from *The World Factbook 2013–2014* and GlobalSecurity.org.

Table 7.2. Government employment percent of workforce

Country	Year	Employee percentage
Japan	1996	8
South Africa	1997	8
Brazil	1996	12
United States	1997	16
United Kingdom	1997	18
Germany	1997	19
Czech Republic	1997	24
China	1996	36
Sweden	1996	37
Russian Federation	1995	37
Poland	1996	57
Belarus	1997	58

Source: Data from Hammouya (1999).

The smaller political divisions such as the states and major cities have smaller, but nevertheless large and essentially anonymous bureaucracies, all with power to impede. The freedom to block joint programs such as high speed train communication, in a democratic state must be weighed against the powers of eminent domain; a comparison of the bureaucratic powers in France with those in the United States serves to illustrate considerable differences in the interpretation of these powers in a democracy.

Business bureaucracies. After the virtues of the individual entrepreneur have been praised it behooves us to look at the size and organization of the firm. In the United States currently the total employment of firms with 1,000 or more employees was well over 70% of the work force. The sometimes heard left wing litany is that the government employees are idealistic citizens of the state who have sacrificed self for public service. The right wing reply is that they are gutless mediocrities who have exchanged safety and quasi tenure rather than face some abstraction called the real world in which only the true entrepreneurs live.

Table 7.3 Top 10 nonfinancial firms by employment

Name	Employment	Total Assets ($ millions)
Wal-Mart Stores	2,200,000	203,706.0
Yum! Brands	537,000	7,774.0
United Parcel Service	435,000	35,500.0
McDonald's	420,000	34,281.4
Kroger	400,000	30,556.0
IBM	379,592	112,724.0
Home Depot	371,000	39,895.0
Target	347,000	41,404.0
General Electric	305,000	645,808.0
Accenture	305,000	16,778.4

Sources: Data from *Financial Times* (2015) and *Forbes* (2015).

7.4 Top 10 private financial firms by employment

Name	Employment	Total Assets ($ millions)
Berkshire Hathaway	316,000	526,186.0
Wells Fargo	264,500	1,687,155.0
JP Morgan Chase	241,359	2,573,126.0
Citigroup	241,000	1,842,530.0
Bank of America	224,000	2,104,534.0
Metlife	68,000	902,337.0
US Bancorp	66,750	402,529.0
American International Group	65,000	496,242.0
Marsh & McLennan	57,000	16,964.0
Morgan Stanley	55,802	803,100.0

Sources: Data from *Financial Times* (2015) and *Forbes* (2015).

Not-for-profit organization bureaucracies. Although it can be argued that the military is part of the governmental bureaucratic establishment it has its own particular bureaucracy that is more or less similar the world over. Furthermore globally it is recognized that in their relationship between themselves and the state the army (with the air force thrown in) poses a highly different threat or possibly aid to the nation state than does a navy. The operational difference between boots on the ground (especially at home) and the fleet at sea still has some validity. Generals are far more politic and prone to enter into politics than admirals. Like most major churches, hospitals, universities and museums armies tend currently to be not-for-profit, although soldiers of fortune exist. The mixture of army goals between political power and profit has changed over the centuries.

The not-for-profit sector deals primarily with religion, war, art, general culture and science, education, and health. Churches, charitable foundations, and the others are either fund raisers or fund givers or both. All of them on the cost side are susceptible to market forces and there are

few physical reasons that prevent them from competing on the demand side or subcontracting to market enterprises to achieve economic efficiency in controlling costs. It is the demand side where the public goods problems appear and the intangibles crowd in. Even their cultural differences may determine mechanisms that achieve similar economic results with different cultural implications. An example is provided in the treatment in the United States tax laws for charitable giving. In Europe many countries support their art museums, symphonies and other cultural institutions by government subsidy. In the United States the relative size of direct government support is far less. Does this mean that in its failure to provide much government support of cultural activity that the United States is a nation of boors? When one adds in the incentives provided by tax breaks the answer appear to be that the subsides are not far different from European countries, but in Europe the nations have elected to have a group of government bureaucrats leaned on by politicians direct the giving, while in the United States the millionaires and billionaires and private foundation bureaucrats call the shots.

We do not have the time or scholarship in a brief book to go into the details of the different styles in bureaucracies in organizations with over a thousand employees;[26] but the differences between a large government and private firm bureaucracy are far smaller than advertised. Possibly the major difference is in the ease or difficulty in hiring and firing. One of the most important problems that faces a mass population large institution world is how to organize more than 1,000 individuals for whatever are the usually only broadly defined purposes of the institution. The rhetoric of profit maximization is only a small part of reality in the operation of the large corporation.

High ranking officers in the army are called generals. High-ranking bureaucrats in private corporations are called general managers; both names imply that they make decisions without knowing many factual details. They are required to base their, general or strategic decisions on the experts, advisors, and lower ranks who have aggregated the information and passed it up in a satisfactory manner.

The problems of organization. Concerning the manipulation of organizations a truly brilliant political science fiction scenario is provided in the story The Squares of the City by John Brunner [Brunner 1965]. It is recommended to illustrate how a politically sophisticated dictator can by utilizing unwitting foreign experts and technocrats provide a veneer of satisfying public desires while doing the reverse. The dictator employs a top apolitical Australian road engineer to come to his mountain capital in a mythical South American country to design a major highway from the coast to his capital knowing that the technically optimal way to the center of the city would involve the destruction of a slum that houses much of his opposition. He is too canny to order this destruction as a goal in itself; but an objective recommendation by a foreign technocrat should provide the cover.

The emerging fourth bureaucracy.

> We have met the enemy and he is us
> — Pogo comic strip

The open frontier where the new occupiers regarded the local inhabitants as a few minor savage tribes that could be dispensed with by the civilized newcomers on the long trek West no longer exists. Seven billion people (and growing) bound together with the computer and the internet, the atomic bomb and intercontinental ballistic missile (ICBM), with the financial network and web of international trade have brought about one world, whether the inhabitants like it or not. The needs for the growth of fully-inclusive international institutions with the ability both to provide international law and standards for many functions such as piracy, terrorism and nuclear control and the ability to enforce the law increase daily. As the importance of international governance of a fully interconnected world grows the world can less afford to have international representatives in a United Nations organizations of the future, be the relatives, playboys or cronies of the ruling cliques of home governments. Much of the permanent employment of the around 83,000 individuals on the UN payroll in 2012 is professional and in one of the many organization such as the Secretariat, (44,000) (UN, 2015); the staffing of the heavily professional World Bank (12,000), International Monetary Fund (2,400), Bank of International Settlements (620), and Interpol (1,200).[27] The European Commission (33,200) pertains to only Europe [European Commission] but it is reasonable to expect that as joint functions beyond that of the nation state are identified and considered organizations at regional as well as world level are called for.

These comments are neither a call for the cures offered by left wing idealism or right wing patriotism in support of the nation state. It is merely the observation that in a world with the current development of science and the levels of weaponry sufficient to wipe out a large segment of current civilization the nations have to opt for the construction of international agencies to control weapons of mass destruction and disruption[28] or risk being reduced by a World War III with casualties of the order of 300–900 million or worse.

The Individual, State, Firms, and Markets

The era of the mammoth international firm is here, the nature of what is meant by competition has changed. Several basic features have appeared. Along with around 78–79% of the employment in the United States in 2008 being in firms of 1,000 or larger, growth of computerization and public bureaucracy has been combined with the separation of ownership and management, and the increase in the non-symmetric relationship between the consumer and the firm as well as the employee and firm. The single individual as a citizen in the good society requires protection against the state; as an owner she requires recourse against the fiduciaries managing her property. As an employee and as a customer, the individual requires recourse against the firm or other institution involved. This fits neither into socialist stories of the virtuous guardians, nor does it fit the tales of the invisible hand and anonymous price but calls for the ongoing ad hoc struggle to provide voice and compensate for nonsymmetric power.

Chapter 8

Uncertainty and Chance

We have layered on complication after complication without adding the pervading ingredient that plays a critical role in our lives. That ingredient is chance and it comes in many varieties. The dominant belief in economic theorizing is that most individuals, most of the time are risk averse. Thus the wish “may you live in interesting times” can be regarded as a curse. This phrase has been rumored to be an old Chinese curse. I am unable to substantiate the rumor, but find merit in the sentiment.

8.1. The Many Aspects of Risk

Before launching into a litany of fine distinctions the two major divisions in the type of risk faced by any individual are labeled by economists as **exogenous** and **endogenous** risk. The first refers to the risk inflicted by Nature or the environment. The second is the uncertainty generated by the actions of the individuals themselves. Two easy examples are given. In the days before our concern with global warming and the human influence on the atmosphere, weather was regarded as an exogenous variable, “It may or may not rain today and there is nothing anyone can do about it.” In playing Poker, after you have made your bet, whether any of the other players will call or raise the bet against you is an endogenous risk created by the strategic actions of others.

The American economist Frank Knight (1885–1972) was concerned with the differences between risk where an underlying probability could be considered and uncertainty where no justification for such a distribution can be made. Dating as far back as the 1930s until now many probability theorists and statisticians have spent considerable time in considering the distinctions between subjective and objective probability. Again two easy examples show the difference. An example of objective probability is your evaluation of your chances of rolling 6 with a die you know to be fair. There are few who will dispute your assessment of 1/6. In contrast your answer to the question, “What do you believe are the odds that a female Republican president aged over 60 will be elected in the year 2044?” appears to be completely subjective based on your conscious and subconscious evaluation of imponderables. Although an odds-maker such as Jimmy “the Greek” from Las Vegas might try to make a market for such a bet.

The subject of probability theory is loaded with many mind bending counter intuitive results, but most of them require more mathematics than we can utilize here and do not add sufficiently to understanding money and financial institutions. There is however one beautifully simple example that illustrate the trickiness in trying to consider the application of probability theory to human decision-making. It is called the Ellsberg paradox. A variant is presented here. Suppose that you are presented with two jars and told by an experimenter that in the first jar there are 50 red balls and 50 white balls; while in the second jar beyond the fact that you can verify later all you know is that there are at most 100 balls. You are asked to draw a single ball from one of the two jars, and if it is red you will win a prize. From which jar do you prefer to draw, and why?

Questions such as this, lie on the boundary between emerging science and philosophy.

The Qualities of Risk

In the development of the many applications of risk to all aspects of society since the late 17th century as betting and insurance became better understood, formalized and institutionalized, the many subdivisions and specialities in the study of risk appeared. For those interested in application and willing to actually deal in risk the institutional details are of basic importance, thus we have:

- Gambling risk involving formal games such as Bridge, Roulette, Poker, Blackjack, also board games including Backgammon and Monopoly;
- Sporting event risks such as baseball, tennis, horse racing, ice hockey, cricket, basket ball
- Risks pertaining to property such as fire, flood and other weather damage;
- Risks pertaining to individuals such as an array of accident and health problems;
- Economic, institutional, managerial and entrepreneurial risk such as product liability, strikes, computer system hacking, theft;
- Financial market risks including identity theft, computer system malfunction, extreme volatility, and leverage dangers;
- Societal and political risks including attempts to assess the probability of riot, government collapse, rebellion, and war;
- So called Acts of God that may even nullify existing contracts; a major volcanic explosion or collision with a large meteor serve as examples.

On Gambling and Probability

The games with tightly formal rules, be they Backgammon, Blackjack, Roulette, Chess, Poker, and Go have all served an important role in the development of a formal study of probability theory, game theory and computer science. The reason is that all of them have formal rules with few if any imponderable features from outside of the game so that the mathematicians have been able to build precise tools to investigate the intricate combinatorics and informational problems that provide a platform for investigating problems in insurance and the mechanism design of incentive systems.

It is in a game such as Chess that we see that no human intelligence is going to be able to predict all the way down to the end using pure combinatoric abilities; but the computer is far better than the human in grinding through thousands of alternatives. The computer intelligence is apparently highly different from that of the human brain and in a game as simple as chess in comparison with politics there is still considerable room to try to find out the psychological basis for how humans play.

A striking mathematical game theory result in the study of Poker shows that the act of bluffing is not merely psychological; but good Poker playing without any personality considerations whatsoever requires bluffing on occasion.

Aggregation, indexes and the creation of endogenous risk. One cannot underestimate the role of the aggregation of information in a mass economy. It is an absolute necessity and it implies immediately that there are essentially next to no major decisions that can be made without having to face up to uncertainty created by the purposeful act of cutting down on the presentation of information.

Possibly one of the most important of sources creating risk in a mass society is the creation of much needed indexes society utilizes to simplify decision-making. Single number indexes for the inflation rate, the level of unemployment, the consumer price level, the stock market overall price level, the net worth of individuals and firms are used daily and are of use to all; but are of considerably more use to those who understand that every index is a one number representation of a complex multidimensional phenomenon and hence presents the distortion of many details that may or may not be pertinent at some time to the decision.

A simple example of the potential for the political influence on index choice occurs when adjustments in pension payouts are linked with the Consumer Price Index. A change in the reading of the index may call for billions to be spent in extra pension payments. There is a political and bureaucratic opportunity to adjust the bundle of goods on which the index is based, or to modify the method of calculation in a manner that could influence the payouts.

On nonsymmetric information, experts, and perception.

> What looks like a stone wall to a layman is a triumphal arch to a corporation lawyer.
> — Mr. Dooley by Finley Peter Dunne

We may be informed about the outcome of a risky event at different times; for example a professional futures commodity trader may be informed hourly about the damage estimate on Florida oranges caused by unexpected frosts; an amateur plunger into the futures markets may not have done his homework and will serve as a source of income for the professional. Much of economic theory ignores or understates the role of expertise in the markets forgetting that the stock market in particular is a secondhand market designed to provide liquidity to corporate shareholders where the nonprofessional buyers have neither the time nor training to read the financial reports of the firms whose stock is being bought.

It is of considerable importance to appreciate the fact that many of us play a conscious professional role in production while displaying amateur low expertise and habit driven roles in our consumption, saving and many social activities. The nature and multiplicity of roles describing an individual's work life and social and consumption life is such that it indicates a large behavioral difference between the two. Possibly one of the important contributions of Keynes was his stress on the behavioral distinction between saving and investment. In particular individuals such as successful medical doctors or lawyers may make the considerable error of thinking because they have high expertise in one profession that they are professionally capable of investing their savings. A well-healed patsy at the table, rich enough and confident enough that he will come back to the table after losing is the dream of every professional Poker player and hedge fund manager.

The Financial Needs for a Loosely Coupled System

The economics of an ideal static equilibrium utilizes the mathematics of equalities and a tightly coupled system where the joys of **supply equals demand** can be proclaimed loud and clear. A dynamic economy requires that a process continues regardless of equilibrium or disequilibrium. This requires, even at its simplest, an understanding of problems where the supply on hand does not meet demand, even if it is for a short time. How that inequality is corrected is critical to our understanding of how the system works;[29] for example when an individual cannot pay back a loan that is due, her supply of money is less than the demand against her. It is not necessarily true that she can refinance in time by merely paying a higher rate.

A common fallacy is to believe that the rate of interest is the price of money. The rate of interest in a money market is the **rental price for the services of money** [30]for a single period and is not the price of the asset money that is quoted in terms of itself and hence has a value of one.[31]

Without going into the technical problems of the variation in the velocity of money one can say that in an economy with a variation in the supply of goods there will be at least a loose correlation between the amount of goods and services and the amount of money given at a more or less constant price level. This is a purposely loose statement about the **quantity theory of money** that can be attributed to Hume, to the Yale physicist Simon Newcomb and to Irving Fisher the great Yale economist, and was stressed by Milton Friedman (1962). Several generations of economists have fought bitterly over the closeness of the correlation and the interpretation of the causality attached to correlation. Does the new money cause the extra production or is it the other way around? The cautious micro-economist answer is that it could go either way and depends on the specific details of the problem at hand. In the simple example below the causality goes from a government policy to create forced savings.

Whichever way the correlation goes the money supply has to be made sufficiently flexible so that rather than see great swings in price not justified by the size of the changes in the physical economy it is easy to change the money supply. A modern economy does this by utilizing close, but not perfect substitutes to the government fiat money. The major one is commercial bank money that in fact is debt, but for almost all purposes serves as a fiat money substitute. A well run economy should permit its monetary supply to wiggle a small amount with ease, but to use constraints on its supply to prevent the price swings from getting out of hand. This is easier said than done as the vast literature on bubbles shows.[32]

Risk and the professional. Contrary to the public image of the great investor or entrepreneur or scientist or explorer as a great risk taker, a more reasonable view is that he is a great minimizer of risk in trying to achieve a risky goal. In pushing back the frontiers, in exploring new territories, in financing innovation, there is hard to assess risk. A basic characteristic of the professional is that he or she attempts to minimize risk, possibly laying it off on the less wary in the financing. A mantra among professional naturalists concerning their field trips is: “you tell me a tale of adventure in the woods and I will tell you a tale of incompetence.” In a like manner there are many niche markets in the financial world such as gold markets, futures markets, puts and calls where the professionals thrive and the amateurs lose.

An Aside on the Wheel of Fortune

One way of resolving an impasse among a few individuals is to toss for it or use some random device that gives the choice to a single individual. In a short story of the great Argentinian author Jorge Borges, The Lottery in Babylon, all positions from tyrant to slave are assigned and reassigned frequently by a mysterious unnamed Company. The dystopian story ends with "... Babylon is nothing but an infinite game of chance." This science fiction nightmare presents the extreme on the endogenous generation of uncertainty as a device of governance. This together with Kafka's The Castle present sobering vistas on the context of bureaucracy, rigid order, chance and chaos in governance.

Are private banks necessary?

The Soviet Union did not think that private banks were necessary. A politically controlled centralized system with branches should suffice in any theories involving human perfection, good will and foresight. Virtually all thoughtful individuals of right or left political persuasions agree that there is a valid need for some form of fiat money whose supply is flexible and rules of operation are given by the laws of the land. The political differences arise in considering the level of governmental controls that are involved in varying the money supply.

Institutions that may have originally come into being to serve a major purpose may evolve into serving many other purposes, thus the term bank comes with many adjectives attached to it. These include central bank, commercial bank, savings bank, merchant bank, investment bank, and many others. These at least, signal the multiple purposes of banking that include varying the money supply, financing the immediate needs of business, acting as depositories for individual savings, lending for mortgages and other deemed to be relatively safe loans, evaluating the creditworthiness of individuals, businesses and municipalities, where the old banking adage of the 3Cs "character, competence, and collateral" apply even today.

Cutting through the enormous details and variations are the plain facts of production that the public may view on many a news program showing the running of the printing presses or the stamping of the mints to produce the physical currency; but that is not where the major action is. Even in a world without risk but with many locations all with differing needs for money if there is a choice that can be made between having loans and deposits handled by a government bureaucracy given its organization and administrative costs or by a set of smaller business bureaucracies called banks operating for profit, the latter may be better.

Physical space is still of importance in trade and a major function of an effective banking system is to evaluate the worth of physical and human capital in every location. Commercial banks must be major local perception and evaluating devices.

The ability of a commercial bank to create credit with less than 100% reserves that is used as an almost perfect substitute for government money means that the answer to the classical question "Do commercial banks create money?" is yes, for all practical purposes (and they can profit by doing so), but **no** in terms of physical reality. The way to make this point reasonably clear is to

view money and all forms of credit fairly unimaginatively as though they were Poker chips of different colors. Suppose that government money is blue, commercial bank debt (often called "money") is red, and individual IOU notes are white. The simple physics problem now becomes who creates these chips, when and how? Commercial banks create only red chips, not blue chips. Where are they in the system at any moment in time? Who destroys these chips, when and how? These are perfectly normal questions that can be asked of any physical system. When we try them on a commodity money system it works quite well. Gold is the color gold; then there may be silver and possibly copper coins for small payments. If loans are possible in the commodity money system we must still create and eventually destroy at least one extra financial instrument, the personal IOU note.[33] A commodity money system could also have other paper instruments present such as bonds; but as soon as we open up the economy to inventing a whole variety of financial contracts the variants are not only endless, but complexities crowd in and opaqueness descends on the system that quickly separates the public from the practitioners, and promotes the mysteries of finance.

Is the National Debt necessary?

Like the private banking system, national debt is not a logically necessary part of an economic system, but it is extremely useful. It offers a potentially smooth way of getting government money in and out of the economic system. The analogy between government debt and the capacitance in an electronic circuit or the dams in an irrigation system are all reasonably good. The availability of a storage device helps to handle a loose coupling between stocks and flows, where a sudden surge in demand or supply can be modified by adjusting the levels in the reservoir.

A sufficiently large national debt, a debt market, together with a set of rules on taxation and on a central bank interest policy provide enough building blocks to construct a flexible mechanism. But the existence of a flexible mechanism per se is not enough to guarantee that those who manage the theoretically adequate control variables will do the right thing. An adequate coordination of the policies concerning debt, interest rate and taxes still must be supplied.

Individuals with an engineering background who consider economic problems may easily be tempted to think that good electronic circuit design and simulation should provide an answer in solving the economic ills of boom and bust.[34] Unfortunately the application of this type of modeling to macroeconomics has not been particularly fruitful possible because in spite of the analogy the empirical difficulties in modeling the influence of time lags and the formation of expectations in political and economic institutions has been heavily underestimated.

Conclusion: The banking system, in its many forms, evaluates risk and creates credit. The presence of the national debt and taxation act as modifiers on the money and credit supply. When the credit system is used badly it creates risk. The creation of any form of credit is always accompanied with some level of risk. A well designed system provides the laws of society concerning default. They indicate society's willingness to accept the overall bill for individual failures. The setting of both the rules concerning the public rules on the granting of credit (such as reserve ratios) and the harshness or leniency of the bankruptcy and default laws are an

economic necessity that reflects a society's overall attitude towards risk. They are public goods permitting a tradeoff between risk–taking and credit creation.

Chapter 9

Innovation and Ecology

The basic observations of Keynes and his cohorts on separate decisions on savings and investment are present in the uncoordinated economy even without outside uncertainty or Lady Luck adding to the problems. Human lack of control and coordination is sufficient to cause economic gyrations. Schumpeter's fundamental contribution to economic theory has been a verbal sketch of an innovating market structure with large firms that is highly competitive, but is far more of a biological and ecological structure than the pure competition model considered by Walras, Debreu and the Friedman school. The concept of creative destruction sketched in his early work has eluded formalization for around a century because it was a far more complex mechanism than offered by Walras and the whole competitive equilibrium school. It was essentially a **disequilibrium** model with a developed financial sector present.

By converting the key aspects of Schumpeter's model into a strategic process where financing, innovation under uncertainty, the separation of ownership and management and the possibility of bankruptcy can all be considered together it is possible to build and analyze structures that are consistent with the concepts of the theory of a purely competitive market, but go far beyond it. With the separation of ownership and management the model is consistent with the structure of macroeconomic modeling by Keynes and others. When the further complications of failure and success are considered the possibility of a chance driven history dependent increasing returns to scale economy appears. This last situation can arise when the firm that gets the earlier lucky break can consolidate it to establish a further lead. This type of situation has been studied by the economist Brian Arthur who demonstrated when it is logically not possible, at the start, to pick a winner.[35]

Size, and the role of ownership and management in the economy

A need to sell ownership shares in a venture can be created by the size and cost of a piece of machinery or building that could be owned by a single rich individual but there may be an advantage to having joint ownership. Small businesses may open as individual proprietorships if the individual is rich enough, or as partnerships, but the limited liability corporation is by far the most preferred form of business organization in the United States. It facilitates the ability of the original owners to utilize other peoples' money. With growth in size, in general, there is a process whereby even although some of the original owners may stay in management, often maintaining control of the firm, more and more of the owners are passive and play little if any role in the control of management.

When a firm grows in size the complexity of organization the growth of the internal bureaucracy may increase by leaps and bounds. Among the larger firms the size may involve different forms of complexity. It may be difficult for many firms to organize themselves like lower order species such as a planarian, where cutting it in half may permit both sides to function fully separately. If the firm is highly complex the vivisection may kill the specimen or call for a fundamental

reorganization.

In the world of high finance organisms that look like large complex entities may in physical fact or legal form be a loosely connected entity acting as a holding company composed of many independent profit centers, often with each center with a separate incorporation allowing it to go bankrupt or be sold without influencing the other parts of the holding company. The central structure provides entities for central financial evaluation and control. With this structure it is easy to sell the subdivisions of the firm, and to buy smaller firms and convert them into subdivisions without killing their physical structures. General Electric (2015) serves as an example. The firm, as a whole, had in 2015 around 35 incorporations. The Bank of America (2015) has over 1,000 incorporations, Exxon (2015) around 45, and the UK Companies House filings for British Petroleum (2015) listed it as having 1,061 different legal entities.

Merger and acquisition rhetoric is often phrased in terms of synergy among the parts in bull markets and lack of synergy when selling is called for. It is difficult to determine whether the synergy exists in terms of real assets and their organization or it exists in financial optimization based on local and international tax and other laws. The determination of the specifics for a doable deal requires many millions to be paid in the employment of investment bankers, accountants, lawyers, management consultants and manufacturing and marketing experts. In each instance, the corporate entity will almost always require funding that results in the separation of a large segment of the owners from the management. Once this has been achieved those primarily passive owners become only one of the constituencies that managers serve beyond themselves. Employees, creditors, suppliers, distributors and the professional financiers belie the claims that the stewardship of the managers is aimed at maximizing short term market price for the benefit of its stockholders.

The concept of corporate democracy with one vote per share leads to a sophisticated form of oligopolistic competition where managements or corporate raiders vie to buy, or at least tie up large blocks of votes from mutual funds, pension funds, insurance companies, hedge funds, and other fiduciaries who hold large aggregates of stocks for the financially unsophisticated who for the most part do not even know the names of many of the stocks in their portfolio and implicitly or explicitly have delegated their votes to the fund managers. The details on how to tie up corporate votes are endless and any attempt by a well-intentioned regulator to load more conditions is an invitation to more unintended consequences. My own beliefs are that a free society is probably better off with permitting a stripping of the corporate vote from the attached shares annually and allowing for them to be sold separately, rather than continue with the sham of corporate democracy.

Capitalism and the rise of the stock markets

The history of the rise of stock markets showed them evolving as the need to raise capital outstripped the resources of even a reasonably rich single individual. A trading journey by a large ship called for breaking up the investment into shares paid for in some manner, and held by the active partner; shares were sold to passive partners and shares promised to the captain and other members of the crew. The financing originally was for a single journey; after which, upon

return all investors were paid from the proceeds of the sale of the cargo. This evolved into long term financing of many journeys and along with the tie up of the length of investment the need for liquidity grew. Turning these shares into instruments that could be sold to a third party provided for the growth of stock-markets whose existence helped the financing to pay for ever larger ships, canals, railroads, mines, large machinery and factories. An unintended consequence of the growth of stock-markets where the passive investor could change her portfolio with ease was the weakening of any lingering concerns with identification or loyalty to any specific firm.[36]

In the 19th century along with the growth of stock-markets a host of laws were introduced that helped to reduce the association of the stakeholder with a firm. In particular limited liability placed a floor on the losses an individual could incur.

The analysts in 1930s to 1950s might have thought that the alienation between much of the owners and the management had more or less reached its limit. They would have been badly wrong; by 2010 an individual whose savings were in her firm's pension fund, if she spent enough time and had enough skill, might discover that she was the part owner of an electronically traded fund (ETF) bought by a fund that was held by a fund of funds held by her pension fund. These layers of the financial cake where a good living can be made charging only a few basis points (a basis point is 0.01%) on billions under financial management are a monument to the importance of providing individuals with the accounting services they need to keep track of their lottery tickets with names such as Apple or Exxon or IBM or Amazon, It is not from stupidity or ignorance that these passive owners do not spend many of their days reading the publications of the Securities Exchange Commission (SEC). Many of them are experts with advanced degrees, but their specialization does not give them the luxury of the time to delve into securities analysis.

Is this brief tale told above a tale of success or disaster? A moment's reflection suggests that it is neither. It indicates how an evolving system tries to cope with a progressively mass participant world with more and more instruments designed to shade distinctions in risk and safely and service the informationally overloaded masses. Before one resorts to free enterprise angel theories by the *Wall Street Journal*, *Financial Times*, and *Economist* readers or devil theories by the chattering classes, the quiche eaters who never met a payroll and the readers of the New York Review of Books we need to consider the proposition that neither of these extremes are true.

The stock-markets imperfectly provide liquidity for many institutions and individuals. They provide an outlet for new issues and they serve the basic function of helping the economy get from today until tomorrow in reasonably good shape without revolution or too many complaints against them. They are in a high state of flux as the increasing technology has undoubtedly destroyed the costly high commission world of the 20th century and the ongoing changes in transactions technology make it unclear as to what institutional structure will emerge next. Apart from pure technology there are three areas where large improvements could be considered; they are **transparency**, **swift redress against errors**, made by the system and the **prompt assignment of individual responsibility** throughout the organization, in such a manner that a client deals with an identified individual motivated to resolve any problem at hand, rather than be

part of the problem.

Innovation and evolution

A basic reason why Schumpeter's earliest and greatest contribution could not be mathematized was that its complexity was considerably ahead of economic theory until recently. It would have been like trying to quantify chemistry before the periodic table and atomic weights had been discovered and understood.

A useful somewhat loose analogy can be made between economic innovation and biological mutation. The economic organism, in one form or the other is able to gather resources that could be consumed and instead devotes them to investing in a process entailing risk where success leads to a new somewhat changed and more viable entity. Failure may leave the same but weakened entity or lead to bankruptcy and the reallocation of the remaining assets.

A mutation takes place when a biological organism invests resources in reproduction, but an error in the instructions occurs such that the progeny is not merely a reproduction of the parent or parents but may be a viable, live new specimen, or a failed or dead mutation leaving over dead matter to be absorbed for other uses.

Financing and innovation

Where do the sources for the funding of innovation come from and how are the final decisions made? In the United States the funds come from a multitude or sources these include the self-financing with savings of the corporations, government finance, investment banks, and venture capitalists and in keeping with the American Dream and the *Saturday Evening Post*, Norman Rockwell cover, from the inventor in his garage, his family, relatives, and friends. These different sources are indicative of the proliferation of financial evaluation, managerial assistance and other decision-making. Before we look at Figure 9.1 showing many interconnected institutions involved in the innovation decision in a complex economy we consider the one-celled economic organism in the form of Robinson Crusoe.

Robinson Crusoe innovates. Crusoe's decision as to whether or not he wishes to innovate has all the potentially separate evaluations and decision-making rolled into one. He does not need a central government, he is his central government. He does not need the institutional device of fiat or commodity money. He might wish to utilize an accounting money just to keep his records and a shadow pricing system to help evaluate his investment opportunities; but in fact he is his own consultant and central planning board and deals with physical investments not financial paper. His savings are limited to capital stock that he has built or found and appropriated.

He will have to give up some of his own time and possibly utilize some of his consumables such as seed corn to his attempted innovation. If he decides not to innovate he has the alternative uses of these resources. In essence as the solitary decision maker he has a pure one person optimization problem of the type much liked by operations research experts and production engineers. No mysteries of finance need to be solved. When we switch to a monetary economy

with many differentiated elements matters change radically.

Considering the Circular Flow

It is the monetary system that provides the forces in a complex economy to promote innovation, as is shown below.

Bringing in money. In the competitive price system interpretation of Walras, in equilibrium supply equals demand in all markets. If we price all commodities in terms of an accounting money then all books balance and individual expenditures equal individual incomes for all. We can build a strategic model that uses gold or a fiat money as a means of payment (Shubik–Smith, 2015, Ch. 5) and although the income and expenditure conditions are still the same the model requires a stock of money to finance all transactions. The size of this stock depends on the transactions technology. If there were no outside uncertainty the amount of money required in the system would be the small amount required to cover escrow arrangement for bridging loans taking care of the small gap in trade where A has relinquished the goods or the money to B, but B has not yet received them, and vice-versa. A small cushion of government money serves as the guarantee. In the perfect free transactions world this amount would be zero, with us it may involve several percent of the trade volume. It may be regarded as the oil that lubricates the wheels of trade or the free energy in the system that would not be there were the system perfect and could achieve instant equilibrium. The amount of cash and notes in current societies varies considerably as is shown in Table 9.1.

Table 9.1 Fiat in current societies

Country	Percent of GNI in currency	Money holdings per capita ($/person)	Percent of GNI covered by the money supply M1
Belgium*	*	*	33.5
Canada	3.4	1,685	37.1
China	9.1	686	50.9
France*	*	*	37.5
Germany*	*	*	48.7
India	11	275	17.5
Italy*	*	*	5
Japan	15.6	5,984	102.8
Sweden	1.7	1,046	43.4
Switzerland	9.2	8,172	78.9
U.K.	4	1,801	47.5
U.S.A	7.2	4,290	16

*Country is part of Eurozone, and therefore total currency is in terms of whole system.

Sources: World Bank, FRED, Bank of England, Bank of Japan, Hexun, Swiss National Bank, Reserve Bank of India, Bank of Canada, ECB.

Manipulating the monetary flow. The political descriptions of the world of free enterprise tend

to misuse the work of the economic theorists by ignoring the many qualifications that do not fit into a rousing platform speech. The preinstitutional world of ADM has only natural persons and implicitly has firms as profit maximizing automata who turn over these profits to their owners and in this smoothly functioning world, income equals expenditure and there is no reservoir needed to cover bridging loans. The circular flow; flows on. The inconvenient fact is that it is only at this level of abstraction, throwing away virtually all institutional distinctions the mathematics can prove the existence of an efficient price system utilizing **either perfect markets or a perfect central bureaucracy**.

The innovation organism. The last figure in this book, Figure 9.1, shows a far more complex organism than the single celled Robinson Crusoe. The ownership still fully rests with the natural persons; but in almost every direction those proud owners are surrounded by an array of fiduciaries available to act as controllers for other peoples' money, welfare and lives. Here in Figure 9.1 we display only the highly aggregated agents; our actual world crawls with detail, and in every day affairs, the detail counts. If the reader were to take away from this book only one item of broad practical use it is that **"The big print giveth, but the small print taketh away."** In order to understand how to finance any item of importance one needs to understand the details or trust someone who does.

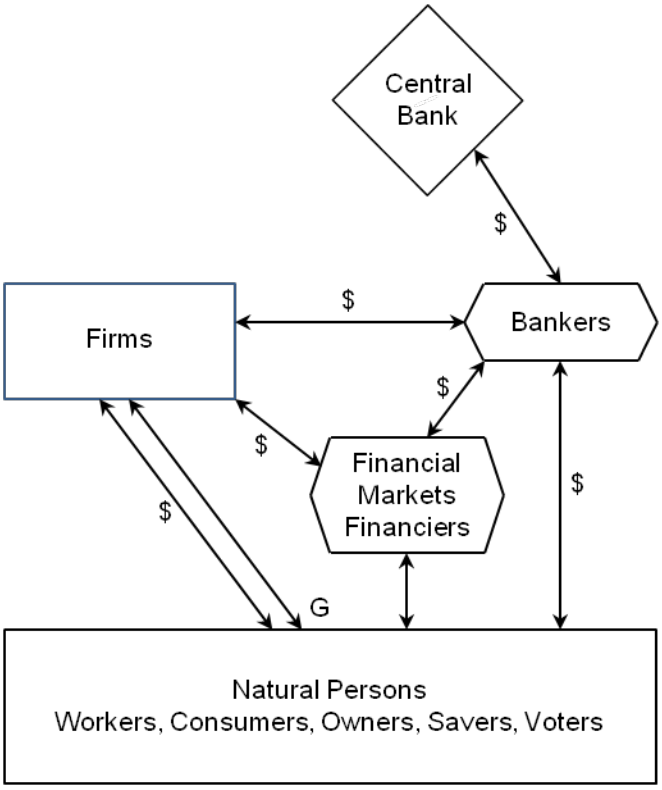


Figure 9.1. A fiduciary economy

We sketch here a simple diagram with five types of agents. Four of them are fiduciaries for the

fifth agent who consists of all natural persons in their roles as consumers, savers, workers of all types, passive stockholders and debt holders and citizens. The other four agents are three financial institutions (including government) that provide financing and guidance to the industrial establishment that produces goods and services. The financing is both for ongoing production and distribution as well as innovation.

Breaking the Circular Flow

Figure 9.1 has many different decision making entities and it is by no means clear a priori who is in control. It appears that control varies with the circumstances. When there is war or the threat of war government pays a central role in encouraging and financing innovation. In associated work my colleagues and I were able (see Shubik–Smith, 2015, Chs. 9, 10) to produce a formal model where the government finances the firms directly by injecting more money into the economic system with reserve ratio banking for the issue of bank debt that is utilized as a substitute for government money. This can be done in many ways. The existence of a commercial banking system combined with the presence of a national debt, government bonds and taxation give a government enormous power and flexibility modified only by political and bureaucratic constraints. Realities that pertain to the specifics of the political and social climate cut down the strategies available to a government.

We make no attempt here to offer the socio-psychological aspects of when and how a potential new invention is in the air. The reading on the atomic bomb is fairly clear the decision to innovate was heavily dominated by politics, government, bureaucracy, and basic science. The tale of the early aircraft and automobiles are different. The history of the spear, cross-bow, long-bow, road systems, rail systems and canals, cotton mills, sewing machines, canned food, rifles, and cannons are all different with the integrating theme of war running through many of them.

As is shown by Crusoe innovation requires the diversion of current resources. When there is a separation of ownership and control and expertise in a monetary economy the nature of who has to give up resources, and how, becomes complex. Crusoe's decision to innovate or not is always voluntary. The concept of involuntary or forced savings is foreign to him. However, if a national government supports a program to promote the production of a newly designed fleet of cargo ships the ship builders can bid up resource costs until they obtain what they need, breaking the equilibrium flow of incomes and expenditures leaving the public as a whole having consumed fewer resources but richer in money in an inflated system where the price level can be somewhat adjusted by the use of taxes and the sale of extra national debt. It can be argued that much of the pent up demand after World War II was financed by the forced saving during the war. Even an example as simple as this one requires a morass of detail and many control variables.

Without invoking war and a high government participation we can consider the private financing for a Google or Microsoft, or Facebook. The basic drivers are different and require many variable simulations to even begin to understand the interactions, but there is a common theme. If there ever was a price equilibrium that equilibrium is shattered and if the innovation were to succeed new products are available hence if matters were to settle down they would be different from the previous equilibrium. But as is noted below matters may never settle done.

Equilibrium restored or permanent disequilibrium? In the highly simplified version of government sponsored innovation that can be solved mathematically,[37] even utilizing only the impact of one chance event the straight logic of the mathematics tells us that after chance has determined whether or not the innovation has succeeded there are at least two new dynamic paths that will be followed. If the innovation fails we have the same technology as previously, but assets have been wasted and the price system disturbed. If there is success there are new goods available. Under the best of circumstances the dynamics of the system could be such that the system might eventually return to an equilibrium; but even in highly simplified models of reality it is inordinately difficult to prove that the system will converge to equilibrium. Furthermore if it does then how long it will take to attain equilibrium will depend on *ad hoc* details and they are generally unknown.

When we view even a relatively simple economy, chance events happen daily, and although chance may bring in some boats that are not steered it also sinks a large number that are steered. At best the system with a single chance event with or without innovation may try to achieve a new equilibrium. No one has been able to fully describe the conditions under which this will be true. Even assuming that we knew, we would still have to face up to the facts that a continuing stream of random events would keep knocking the system away from any equilibrium even if it existed in theory. As already noted above, the work of Arthur suggests that with a stream of chance events each period the process could easily become history dependent and by no means even guarantee that an innovation with the best technology would prevail. Good luck at the start may enable an inferior technology to obtain a sufficient lead in acceptance that an intrinsically better product fails before it can reach a high enough market share.

War and innovation

> Fear not the atom in its fission, the cradle will outwit the hearse,
> Man on this planet has a mission, to survive and keep on getting worse.
> — Samuel Hoffenstein, *Pencil in the Air*

An ominous aspect of major innovation is that war or the threat of war appears to be its great instigator, sponsor, and correlator in human society. The sociology of war is an unpleasant topic and is not a subject that should be discussed by nice people in polite society. Many of us do not have the stomach to watch open heart surgery or even watch a professional butcher slaughter cattle, even though we are willing to have surgery, to enjoy a good steak and to have others drop bombs from great heights.

A constant theme in these chapters is that correlation is easy and often suggestive, but the establishment of causality is beset with traps. As no scientific attempt is made here to establish causality between war or the preparation for war and the flourishing of innovation I label my beliefs as a strong conjecture, that the causality is often there, but leave it to the individual reader

to accept or reject this proposition.

Chapter 10

Alice in Wonderland and Mathematical Institutional Economics

The title of this brief chapter is based on the observations that Alice in Wonderland made when she encountered a peculiar structure in a croquet game. These are relevant to our understanding of control in reality as well as fantasy. Furthermore when she ventured through the looking glass she found different laws of Nature and learned the secrets of the power over words, sought out by many a politician.

When we get through the looking glass of money we enter into a world parallel to the real economy. It is called finance.

Upper and lower bounds on the need for money

It can be shown that the very maximum amount of money that an exchange economy will ever need to run efficiently is the total value of the whole economy at efficient market prices. This happens when each individual simultaneously in each period puts up for sale all of his assets. This could happen in the event that the individual wants nothing that she owns, but wants only items she does not have. An ordinary wage-earner usually sells only her time and buys consumer goods and, possibly saves. In contrast a manufacturing or other firm may buy many assets and inputs and sell many outputs and assets

Although the practical example below sounds unreal and the sort of stuff that underemployed academics can dream up, it illustrates some problems in wealth evaluation and taxation that a local government and many a well off individual has learned to appreciate. If we have an income tax, the tax collector needs to measure income. But income not only involves one's wages and business profits but also a change in the value of all of one's assets. These are inordinately hard and costly for a tax collector to evaluate. But a scheme that was considered some years ago in Chile was that a tax payer would be required to place a valuation on her own property understanding that it was also an offer to sell it. This may work well for changes in land prices when a new road goes through to the ski slopes of Portillo. This was an excellent solution to an *ad hoc* problem, although the theory behind it is general, the application calls for specifics and it may not become law if the individuals are real estate developers who hold land and have enough political clout to block this evaluation. Unfortunately for other problems such as evaluating human capital it will not work without slavery. Human capital evaluation requires Big Brother to evaluate you looking at you as a machine or slave. An individual's disclosed earning power is about as good an indirect minimal evaluation of human capital that is reasonably easy to track.

The minimum amount of money ever needed in an economic transaction is obviously zero when no one wishes to trade as the individuals are all happy with their own assets, or when they use barter only. Autarchy is almost always economically inefficient in contrast with trade, but it is the ultimate in decentralization. In trade, depending on the actual technology of payments and the ability to net out payments by some individuals who run a tab on each other, the amount of

money needed to support annual efficient trade is just a few percent of the yearly volume of trade.

An aside on flim-flam and the measure of wealth

A great vicarious game played in the United States and possibly now in China, Hong Kong and Singapore is looking at lists of billionaires and hunting for the richest person in the world (leaving out dictators who mix money and political power). This spectator sport has several fun features to it. It appears that one can informally divide the list into at least two classes, the true tycoons, usually at the top of the list and often trying to hide their wealth or call as little attention to it and to their public persona as possible. At the other end of the list are the flim-flam artists, hustlers and braggarts who use creative accounting, grossly over-evaluated estimates of dubious assets to the point of lying while trying to appear in the public eye as much as possible to encourage the gullible to play at their casino, be it a hedge fund with Ponzi game advertised returns, or a how-to course from the master at a price. In the physical sciences the local units of measurement like the meter tend to be more or less constant. In economic measurement valuation in money, at best is somewhat flexible.

The real and the financial economy

If we are able to evaluate the whole economy in monetary terms we have two economies: The real asset economy and its counterpart through the looking glass, a financial asset economy. The financial economy has great liquidity. It takes little time to transfer ownership of 1,000 shares of a steel company if you are a shareholder who thinks steel is becoming obsolete, but the liquidity of the physical asset, the steel plant is another matter. Is very little, it could be run with little maintenance in order to cut short-run cash flow, it could be abandoned and rust over the decades, or be converted to other manufacturing or nonconventional retail space. The real economy puts the bread and butter on the table. The financial economy is more attuned to costs and prediction of costs and changes in demand for the bread and butter. Both are needed.

The one to one measure of money worth of all real goods is useful for individual wealth evaluation purposes in a stable ongoing economy. It is less meaningful, but even fun and fodder for a popular Sunday newspaper financial section to publish items such as “How much is the United States worth?” There are several different ways to cook up such numbers. A quick bounding rule of thumb is that the asset valuation is somewhere between 4 to 8 times GNP. The approximations all come with a host of assumptions, such as we are concerned only with an ongoing economy in a more or less stable polity close to equilibrium where the aggregate production conditions can be approximated by some simple function. A 2015 valuation for the United States is $85.9 trillion (4.82 times GNP) or $259,000 per capita, in contrast with a per capita wealth of $452,000 in Switzerland (Credit Suisse, 2015). The US 2014 GDP and national debt were $17,528 billion and $18,527 billion or the ratio of debt to GDP was around 105% in

contrast with the Swiss National debt at 48% and the Japanese at 243% but as is often the case an outlier number requires specific interpretation and detail and is often not easily compared with the others (IMF, 2014).

These rough numbers raise questions on how well a country can service its debt. This requires the reminder that if the debt is held only by its own citizens, it represents an internal transfer of buying power within the country and is basically a problem of distribution not magnitude. If much of the debt is held by foreign sources the implications are considerably different.

The capacitance value of a national debt has been progressively recognized by economic theorists since at least the founding of the Bank of England. Bad analogies between the functioning of the government economy and the functioning of the family economy still leave the concept of the national debt as an instrument of value to the economy as a much misunderstood topic and perfect material for any demagogue to thunder against without a basic understanding of economics.

The Croquet Game and the Economy

> Alice thought she had never seen such a curious croquet-ground in her life; it was all ridges and furrows; the balls were live hedgehogs, the mallets, live flamingoes, and the soldiers had to double themselves up and to stand on their hands and feet, to make the arches.
>
> — Lewis Caroll, *Alice's Adventures in Wonderland*

The problem facing the mathematical institutional economist is illustrated directly in Alice's attempts to understand and play the croquet game that faced her. Any good mathematical theorist who knows how to describe the formal playing ground of any board or field game has few difficulties in laying out the formal rules and describing limits imposed by the rules of a formal game has trouble with Alice's croquet, but any historian and student of institutions knows that what may be assumed to be well defined and permanent in one context is fluid in another. The Alice in Wonderland game lacks the antiseptic formality of an ordinary game. The ability to play the Alice game is not only not covered in formal economic theory, but needs the skills of the social-psychologists and others. An honest economist or political scientist must admit to the limits of formal analysis in concrete application. We are only beginning to understand complexity[38]. The developments from other social sciences are still to come. Yet world over the dangers of coups, dictators and demagogues are still with us and the developments in weaponry for all have far exceeded improvements in the understanding and control of political process.

The wider the scope of the socio-economic problem the closer is the croquet game analogy. It has been suggested that mere millionaires operating in relatively well-defined businesses need the services of good economists and technical personnel. Billionaires require gurus and astrologers.

On words and finance

> "When I use a word" Humpty Dumpty said, in a rather scornful tone, "It means just what I choose it to mean — neither more nor less." "The question is" said Alice, "whether you can make words mean so many different things." "The question is said Humpty Dumpty, which is to be master, — that's all." … "That's a great deal to make one word mean," Alice said in a thoughtful tone. "When I make a word do a lot of work like that," said Humpty Dumpty, "I always pay it extra."

A hedge fund frequently does not hedge. It has a euphemistic title to avoid forms of government supervision. A merchant bank no longer has anything to do with merchants and is probably a dying form anyhow. An investment bank may not be a bank. In the institutional thicket that represents modern finance the label on an institution or financial instrument that was given when it first appeared may no longer represent its prime function, if it ever did. This flexibility in language may easily be used, sometimes usefully, sometimes harmfully to calm down the unwary. In particular, many a bankruptcy may be put off by a reorganization and refinancing that is substantively an operational bankruptcy but appears under a less pejorative name. This change in nomenclature may help to prevent a panic. The economic analyst is well advised to consider the current functions of the instrument or institution rather than accept its original name.

W. S. Gilbert's Little Buttercup in *HMS Pinnafore* noted: "Things are seldom what they seem, Skim milk masquerades as cream"; so it is with many financial instruments. If you do not understand the functions of the instrument, stay away or the cream you contribute will quickly end up as skim milk.

Chapter 11

The summing up: Economics the next hard Science?

The growth of analytical economics and the understanding of finance and problems of guidance or control have been considerable since the end of World War II. From Adam Smith until the World War 1 there was a single unified topic known as Political Economy which had for the most part two related roles, it provided a philosophical and moral commentary on the aspects of symmetry, fairness, equity, efficiency; and with a different emphasis gave direct operational advice to the political establishment. Mathematical economics existed until World War I only as an obscure occupation or the harmless hobby or double acrostic of a handful of established economists who had minor influence outside of the academy. Formal probability theory and applied statistics were hardly in broad acceptance beyond the needs of the tax authorities and military conscription where knowledge of population size and make up was required. Operations research and management science did not exist, operational gaming was in use only by the military, although a good intellectual gamesman wanting to show off at an in-crowd cocktail party could dust off his knowledge of Sun Tzu, (circa 500 BC) renowned Chinese General and author of *The Art of War* as the first great practitioner of operations research, gaming and logistics; thereby showing that there is nothing new that cannot be found in history.

Between the two world wars Political Economy started to split into many parts and became far more detailed and technical. The advice givers to the political and bureaucratic establishments formalized the applied art and science of macro-economics. Welfare economics began to emerge with an increased use of mathematics to tackle the questions of moral philosophy; micro-economics split into studies of the firm and competition of the few while the study of both the competitive and central government use of the price system evolved both as a technical debate and a political football. Economic history and institutional studies were enlarged with subfields such as the history of economic thought.

After World War II there was an explosion that not merely fractionated the specialization still further, but took great steps in quantification. The expansion was based on the unprecedented growth of the ability to compute and to communicate almost instantly anywhere the results of the work. During the war operations research had flourished, after the war it was followed by a flowering of computational methods and an unprecedented growth in our understanding of both probability theory and applied statistics. Mathematical methods, flourished and computer science and artificial intelligence all added to the forces that transformed both empirical and theory studies in economics. The event of game theory, at first scorned or laughed at by the old guard, with senior professors such as Jacob Viner in Princeton saying in class if game theory cannot even solve Chess what conceivable use can it have in economics, swept into all of the social sciences and connected with the formal study of information distinguishing between the syntactic use of information developed in Shannon's theory of information and its semantic relevance in the study of threats in bargaining studies.

In the 1940s the formal consideration of finance as an important and highly relevant aspect of

economic life had hardly begun. An undergraduate in mathematics could look forward to a life as a school teacher in mathematics, and if he was very good at summing interminable series of payments and amortizing loans using a crude business calculator, he might get the plum well-paying job of a junior actuary.

Between the 1950s and now finance has become a major discipline in economics and the financial markets have become a highly remunerative haven for probability theorists and physicists. A by-product of this activity has been the formation of a subfield called econophysics. To put it mildly this is a far cry from Adam Smith and is highly mathematical. The phrase "let a hundred flowers bloom; let a hundred schools of thought contend" attributed to Mao Tse-Tung may not have applied to his rule of China, but it does apply to the development of the many sub-disciplines in economics.

Once matters become complex if one intends to study the phenomenon at hand context matters as the way to guide any simplification and the construction of a relevant model. And one also needs a cleanly defined question with an appreciation as to what constitutes a useful answer. Much of economic advice, especially when it involves specific application is a mixture of the quantitative modified by the qualitative. However basic economic theory, stripping down the underlying structure of the minimal control structures of an economy appear to be reasonably amenable to quantification and should at least in physical structure (not necessarily behavior) obey the laws of logic and the basic rules of a local physics such as the conservation of matter and energy. The title of this chapter is `Economics the next hard science? The answer is clearly no for macro-economic advice giving. Special applied topics such as the design of special financial instruments are getting to be more and more quantitative with sophisticated probability theory playing a role. The underlying basic dynamics of models of money and financial institutions are amenable to gaming experiments and although the experimental gaming of financial structures is in its infancy the tendency towards it developing as a somewhat harder science than the other social sciences appears to be likely even if field or *in vivo* experiments are difficult to control

With the growing understanding of the importance of information, networks and complexity in both computer science and biology the new fields of bio-economics and neuro-economics have appeared. One can now see what parts of the brain are activated when an individual makes a bid or bargains. It may take many years before we can interpret the significance of this behavior.

The journey through the chapters of this book has offered an overview of the evolution of the modern economy winding up with clean simple models that both illustrate basic concepts of the roles of government, and law in the utilization of markets and prices in any economically viable nation state. The simple models can and have been utilized for exposition and as experimental games; however abstract theory is not meant to be useful directly in application but it provides both logic and a toolkit to help those concerned with application build detailed *ad hoc* models rich in specifics that are needed for immediate policy advice.

When the analysis moves into items such as health care, climate change or social security the variation in understanding and basic beliefs of different segments of the population is enormous

and many applications in broad political economy call for compromise on beliefs far beyond the gathering of facts or display of technique; but institutional and cultural variations are such that all applications require an a*d hoc accretion* of case history to build up a broader basis for a politico-economic solution. A well- known important case in point is the determination of the prices of drugs for the cure or control of all diseases where the patients with the diseases are not faced with normal economic choice and as there is no meaningful definition of pure individualistic economic choice it must be replaced by politico-socio-economic choice.

A Summary on money

> Money, money, money makes the world go round
> — Song in *Cabaret*

Before dealing with the last chapters where the controversy about political economy cannot be avoided I conclude with notes on money. The existence of money is an emergent property of an economy. Money is a systemic phenomenon and has many functional properties. A listing is given commencing with the usual popular textbook properties.

1) It is a means of exchange.
2) A store of value.
3) A numeraire or the unit of account.
4) An ideal money has the properties of:
   a) durability, it is a durable with no physical depreciation.
   b) Anonymity: a pure money is a bearer instrument. A dollar bill or coin, unlike a bank credit has no owner name on it;
   c) transferability, its ownership can be easily moved from A to B;
   d) divisibility;
   e) portability;
   f) cognizability;
   g) fungibility; and
   h) A good money is highly difficult to forge or debase.
5) Money is an economic aggregating device for measuring individual wealth.
6) ln physics the meter is a constant measure for the whole locally Euclidian planet, but the dollar or another fiat or a gold money varies in its measure of worth over both space and time. It is a decent constant approximation over a small geographical area for a more or less short time.

Money and a broad array of often mutating financial instruments provide the control instruments for the evolving economy.

Credit and near monies

The key distinction between money and near monies is that money is either a commodity or a

synthetic commodity and thus unlike any form of credit has no offsetting instrument on the balance sheet other than the *pro forma* entry on the debit side of the balance sheet entitled Ownership. All simple credit arrangements involve two agents and two instruments, one the IOU of the debtor and the other a promissory note of the creditor such as a bank deposit or fiat money itself paid by the creditor. Two simple examples are a consumer loan from a commercial bank where the consumer is the debtor and obtains $1,000 now in return for her promise to pay $1,200 one year from now. A second example is where the consumer goes to the casino and buys $1,000 of casino gambling chips that she can then redeem for $1,000 in the national money a few hours or days later, having thereby made an interest free loan to the casino. A doting father of a near bankrupt casino owner son could attempt to avoid the complexities of business laws on loans by merely buying the casino's chips and holding them indefinitely.

A Comment on fairness, public, and private property

Milton and Rose Friedman (1980) in their book (and TV series) *Free to Choose* quote and contrast the phrase of Marx "To each according to his needs and from each according to his ability", with British labor's stress on fair shares for all. They do correctly identify that much depends of the definition of "fair." The paradoxes that arise in defining fairness are precisely where modern technical economics and game theory have made considerable progress that never reaches the popular press or political rhetoric.

It should come as no surprise to a thoughtful person that there is no simple answer, but a mixture of analysis and values permits reasonable people to construct lower and upper bounds on acceptable distributions and behavior. Statements such as there should be some form of safety net for the destitute, or some limitation on the length of a patent are less statements of principle than on socially acceptable levels in operation.

The devising of any policy is often accompanied with the use of politically loaded words such as "the rights and responsibilities of the citizens." It is on these two words: "rights and responsibilities" where the social premises must be spelled out in order to be able to sort value systems implicitly assumed from the economic analysis.

Private property and behind the veil of ignorance

Two somewhat technical points raise and hopefully clarify basic questions concerning individual private ownership and the concept of fairness or symmetry of claims. The Harvard Philosopher John Rawls (1921–2002) in his book *A Theory of Justice* introduced the thought experiment concerning decision-making from what he called the "original position." This device which is explained below can be combined with a concept in game theory to illustrate the role of initial ownership claims and the two of them can be put together to produce a simple experimental game that can and has been utilized.

Much of cooperative game theory and its application to economics and political science is based

on a tabulation of the estimated powers of all different coalition structures that could be involved in any game involving a few players. This tabulation is formally called **the characteristic function** of cooperative game[39]. As the number of agents involved increases the number of potential coalitions increases by the power of 2. This means that a game with 20 players has 2^{20} or around a million potentially different coalitions that can form. There are few situations where, in application, one is going to try to mess around with a million coalitions. In most situations of interest there are either no more than five or six active parties and often there may be one or two large agents in action with an ocean of thousands of small agents, each individually with next to no power. An example is Government and all strategically weak citizens.

Fortunately a simple experimental game that explains both Rawls basic idea and the characteristic function can be illustrated by a game with just three players. (This is formally defined in Appendix B.) Let us give the players the names Adolph, Benito, and Charles. We introduce the notation

v(Adolph, Benito, Charles) = 30.

This says that all three of them, if they cooperate could earn 30 together. If we were Bentham or some other believer in a mystery good called utility that might be 30 utiles. Less imaginatively if we were in an economics department laboratory the reward for the students might be $30.

We list all of the two person coalitions that might form and give them the following values:

v(Adolph, Charles) = 20; v(Benito, Charles) = 20; v(Adolph, Benito) = 10,

and if any of them acted purely alone his payoff would be 0, hence

v(Adolph)=0; v(Benito) = 0 and v(Charles) = 0.

The cooperative game problem is how should they agree to split to $30 that they could obtain by acting together?

In the experiment the student are given 15 minutes to sign an agreement on how to split the $30. The game is over when all three students have signed a contract indicating the agreed upon split. For example, the message could be (15,10,5) agreed on by Adolph, Benito, and Charles, or if only two are willing to sign it might be "(11,–,9) agreed on by Adolph and Charles." If no document is signed before time is up all individuals get nothing.

The game as described above can and has been played easily in any classroom. One does not even need any fancy equipment that is usually associated with an actual gaming laboratory. The results tend to give the lion's share to Charles who appears to be the most productive. Whether this is due to his initial talents or ownership of other assets is not specified but is reflected in the characteristic function.

We can try out a variant of this experimental game by making concrete the thought experiment suggested by Rawls. We play the same game as described above with one twist. The three

players are told that they will not find out who they really represent until after they have finished the negotiations. We can make this absolutely specific by having the three players use the names I, II, and III. After they have told the referee how the money is to be split among, Adolf, Benito and Charles the referee tells them that the name I stands for Benito, the name II stands for Charles, and III stands for Adolph (or some other possible assignment) They are then paid accordingly. Rawls regards this as decision-making `behind the veil of ignorance' where you do not know what your natural endowments or initial inheritance is going to be before taking action. It should come as little surprise that in such a game there is a tendency for the players to select (10,10,10).

Most of us will defend our ownership rights to our own talents and many will also include our entitlement to any physical assets we have inherited from our parents or others; but the argument over fairness and symmetry helps to bare, even at this level, both our rationalizations and the many problems in policy implementation of property rights. For example a proponent of rugged individualism might wish to support no taxes whatsoever except for a 100% inheritance tax. This might look attractive until one considers how to implement it. Milton and Rose Friedman (1980, pp. 134–138) at least admit that the ethical issues are subtle and complex but their resolution appears to be neither.

Theory and dynamic reality

The mixture of philosophy of Hume and Smith and insightful *ad hoc* nuanced observations of Smith provided the foundations for a formal economics. The approximations of Marshall providing for the insightful use of comparative statics along with good enough definitions of firm and industry, with some glimmerings of mathematization in the appendices, provided economic insights that not only continued the British tradition of economic thought providing policy advice, but vastly expanded the popularity of economics as a topic for study. The works of Cournot, Jevons, Walras, Menger, Pareto, and Edgeworth provided much of the basis for the development of marginal analysis and mathematical economics based on the idea of maximizing some form of payoff using calculus to do so. The formal development was oriented heavily towards equilibrium theory where equilibrium is reached when no one can improve her payoff by further individual action. Microeconomic advice and application was heavily based on marginalism and comparative statics.

The great influence of Keynes and of Schumpeter took off in other directions. The former led to the formal development of the applied field of macroeconomics; while the latter called forth the development of, and the view that innovation, rather than price is the major driving force in an enterprise economy. Both writings in highly different ways were concerned with money, finance, process, dynamics and disequilibrium.

The position developed in this book is that the basic sociopolitical and economic realities are such that there is no general dynamic economic theory at the level of the well developed static theory of general equilibrium. The closest approach to a general dynamic theory for a highly-

limited set of models was provided brilliantly by von Neumann's highly simplified but basic fixed proportions technology model and the work of David Gale. A fixed proportions technology is like a simple cooking recipe where you are told that if the ingredients given serve 4, double all of them if you wish to serve 8. It is usually assumed in cooking that one's kitchen has excess capacity so we do not double the amount of kitchen needed when doubling the ingredients for a recipe. In a whole economy the doubling of output usually calls for the doubling of many capital goods and the comforting analogy between the individual's economic rules and the economy as a whole is often wrong.

As soon as one considers an economy with more than a few periods the need for key relevant details explodes. Many specific parameters are required to facilitate analysis. In particular items showing the time lags in the bureaucracy and in the speed and clarity of the politico-economic process are needed. These considerations influence the ability of the economic advisor to estimate whether even a well-researched and supported *ad hoc* model will lead to a doable program or will it be strangled by political and bureaucratic or other time lags imposed by the society?

Low dimensional models may be used to see "the big picture", a highly aggregated overview that serves as a basis for qualitative advice and helps to provide a link between well-developed economic theory and the actual socio-political world where many politicians sell the sizzle but the delivery of the steak is left to the administrative structure that they may not have.

A reconciliation between micro- and macro-economics and between theory and practice has already taken place. It involves nothing more than the full appreciation of the methods of careful model building[40] and the existence of institutions that can carry the dynamics of economic process with socially and politically acceptable guidance.

This book has been aimed at providing a nontechnical description of technical economics. The technical work utilizing political economy in touch with both physics and biology, has been devoted to providing a reasonably solid scientific basis fort the basic links between static economic models and the welter of behavioral dynamic models of the economy. It stresses that the concepts of minimal institution and minimal information conditions provide such a link. However the direct application of a given process model to any part of the economy requires both a well-defined question to be answered and the addition of the appropriate details of structure and the specification of the context driven varieties of behavior assumed in application.

Mathematical Institutional Economics and Econo-physics are not oxymorons. Given the complexity of the political economy an underlying appreciation of the logic and combinatorics of organization is required. In application this knowledge is manifested in the specific structure of the institutions that are the carriers of socio-politico-economic purpose. Furthermore in the study of the key role of money and financial institutions the consideration of the elementary aspects of physics is called for. These include conservation, the rules of scaling, the derivation of measures, the selection of the level of detail,[41] and the roles for symmetry, coordination and symmetry-breaking that appear in physics. They appear as the natural properties of a monetary system.

With the features noted above it is reasonable to expect considerable further quantification in economics. Even though the chances for precise long term prediction of the trajectory of the economy appear to be negligible, the possibilities for the development of decent short term procedures to aid in short term guidance appear to be reasonably good. The broad imposition of good rules to prevent certain forms of dynamics is different from being able to predict the dynamics, yet it may provide worthwhile safeguards. A simple analogy is with preventing suicides on the Golden Gate Bridge in San Francisco. There is no way short of removing the bridge that one can guarantee that there will be no suicides from the bridge. At best one can aim for getting down to a low and grudgingly acceptable number. There are several highly different ways that the problem can be tackled. A simple, authoritarian and reasonably effective way in cutting down suicides is to close the bridge to pedestrian traffic, destroy the path and erect the appropriate barriers at each end. A second socially conscious way is to expand the psychiatric counseling program for all individuals in the Bay Area thereby striking at the socio-psychiatric roots of the problem. A third is to leave the path open and obtain one or two independent studies on the costs and effectiveness of extra policing and a barrier design, with the decision made by city government or a public referendum.

The fundamental differences in approach are that the first removes social choice; the second provides an idealistic economically implausible attempt at individual behavior modification in a mass society and the third attempts to solve a specific problem to lessen the number of suicides subject to leaving freedom of choice in usage but with extra constraints in the form of barriers and more patrol. The specific structure is limited by socially acceptable costs.[42]

More generally the judicious placement of limits or barriers on the domain of choice is qualitatively far different from any attempts to predict and micromanage individual choice. In formal terms one involves the placement of extra boundary conditions on the choice sets of the individuals, the other calls for the understanding and possible direct control of the choice behavior of the individuals.

Looking at potential housing bubbles, placing a 20% cash deposit condition on house purchase is an anonymous governmentally passive constraint on all individuals that could make it far harder to maintain a bubble than a 0% cash condition. A libertarian might argue that a government credit requirement is the overstepping of the bounds of individual liberty. The view here is that this type of general limitation on the rules of the game for all is the task of a democratic government. Where the limits lie is a central part of the ongoing debate.

Chapter 12

Political Economy and the Future: A Brave New World?

It is easy in even the most abstract of topics such as mathematics, for humans to display passionate difference of opinion concerning the relative importance of developments and the conjectures and guesses about open problems. One cannot keep passion and unproven belief out of the discourse. Fortunately, at least for the mathematicians, the level of abstraction of the subject protected many of them even from the politics of a Stalin. This is not so with political-economy. Our best hope is truth-in-packaging by all participants hence every author should give some personal disclosure to provide aid and insight to the reader as to his or her potential modeling biases. Rather than break the flow of the text, my own biases are given in the large endnote here.[43]

Much of this chapter and the last chapter are based on my perceptions as a citizen combined with my thoughts as an economist. The discussion in the previous chapters has provided a nontechnical description of the methodology developed to provide a scientific basis for understanding the roles of money and financial institutions as a critical part of the politico-economic structure of society. The analysis of how a part functions does not provide an analysis of the whole. The intelligent and responsible citizen should be interested with the whole. It is here where any honest economist knows that the scientific boundaries of the profession have been reached and that further commentary has to be a mixture of personal perception, scientific training and individual moral beliefs.

One world, war, and the transformation of the nation state

The developments in last 30–40 years in communications, computation and the lethality of weapons, have spelled out changes that have by no means been absorbed by the societies of the world.

Complexity is not a buzz word and lethality is not a trifle. The nation states as we know them currently are a transmuting species, but they do not transmute with ease. Whether we like it or not we have entered the era of a completely connected world for many important problems that cannot be handled by a nation state alone, in particular international trade, monies, and credit, immigration, transmittable diseases, defense and terrorism require some level of global governance. This means that if we are to survive new international structures with power to act are needed.

In the last two centuries the guidance of policy on war, money, immigration and common natural resources such as the seas and climate were more or less the domain of the nation state. This luxury is no longer there. In essence all of the frontiers have closed except space. The nature of these functions in a closely connected world, if individual freedoms are to be preserved, requires many new institutions aimed at handling and coordinating specific functions at the global, continental and more local levels and policing them.

The closing of the system and the compounding of connections has increased feedback and diminished the buffering provided by slow speeds of transmission and the previous near-isolation of many systems. The instant dissemination of news or rumor together with the Web, the i-phone, modern transportation and weaponry; the presence of instant international editions of publications such as the *Wall Street Journal* or the *New York Times*, bring Washington, Tokyo, Beijing, and other capitals in 2015 closer together than state capitals such as Albany, Trenton and Hartford were in 1945.

On mechanisms and institutions.

> "It goes without saying," said the Grand Prince, "that justice cannot be done to all parties at once. Indeed they do not demand this, however loudly each cry that justice be done to itself in particular. For people know very well that in the ebb and flow of politics each Party will at some time have its chance to settle accounts."
>
> — Werner Bergengruen (1952, p. 231)

When analysis moves into politically and socially sensitive items such as climate change or social security the quality of the debate and the nature of application is not purely scientific. The basic assumptions utilized by any set of scientists or technicians, no matter how distinguished, are challenged by the extreme differences in values. One can make out a case that if the legally elected representatives of Kansas or Indiana[44] wish to vote that the number π be set for all legal purposes at $\pi = 3.14$ competition in manufacturing of high precision wheels and pressures from the law courts will eventually correct this difference between the legislators views and the scientific facts. The current debate on human influence on the climate has experts and politicians on both sides and in the long run almost all scientists will be on one side. When this point arrives it is possible that it will be too late to act.

The large doctrinal battle in Economics and Political Science is fundamentally on how much power should government have in society and the most viable answer to this question appears to be that there exist processes that call for all resolutions to be considered *pro tem* and reconsidered when the pressures build up sufficiently. Laws, customs and mores all exist on different time scales. Whatever the processes may be they spell considerable changes in the governance of the nation state.

Requirements for a viable world?

We have noted many institutions supporting the dynamics of economic activities in villages, city state, empires and modern nation states. Can anything of general practical use be gleaned from this tour? My suggestion is yes, quite a bit.

The beautiful, elegant axiomatic treatment of the perfect coordinated free forming price system bringing plenty to all untrammeled by the interference of government and the oppression of unneeded law, when appropriately misinterpreted provides the dreams that serve to feed the Ayn Rands, the Tea Parties, the Cato Institutes, many in the Republican party, right wing literati and charismatic politicians who are either true believers or first class manipulators or both. It also

provides anathema for the currently fairly diffuse left wing in United States politics many of whom with no large freestanding political parties of their own have to settle for the Democratic party.

The very chasteness of the abstraction with its utter lack of institutional clothing allows the utopian right to build whatever they want and legitimize their fantasy with the blessings of a theory that never supported their claims.

The same abstraction twisted one way into parody by the right wing is twisted into a different parody by the left wing. The left wing may not claim that starvation or plague, or disease or overpopulation, or abject poverty are curable by diligence and pure self-help. They do appear to have observed a few facts of life that show that it may be easier for a virtuous uneducated boy or girl to thrive somewhat better in the United States than under an Angola dictator or Haitian president supporting free enterprise, and that this might have something to do with a quality of government and law; but they tend to believe in the beneficent bureaucracy, the daddy who will make all things better.

Many of the sociological facts presented by Karl Marx and other patron saints of the left provide the material from which a different utopia may be built. Looking at the history of Germany and the Soviet Union, prior to Hitler's and Stalin's consolidation of power it appears as if it took two promised utopias to build two functioning dystopias.

Irving Kristol, a minor figure of the New York literati commented on his conversion from being a Trotskyite to a neo-conservative. He defined a neo-conservative as a liberal who has been mugged by reality. This author finds it somewhat difficult to regard a Trotskyite as a liberal. The paths of Trotskyite to neo-conservative and vice-versa sound more like religious conversions than reality training.

It requires little analysis but the appropriate rhetoric to offer the utopia of the left as the benign big government accompanied by virtuous top bureaucrats and selfless union leaders devising just taxation for all. It hardly matters whether it is left or right, the popular saviors are waiting, with speech in hand ready to volunteer to replace **the past imperfect** and **present intolerable** with **the future perfect.**

Schumpeter (1950) in his book *Capitalism,Socialism and Democracy* spends the first part with a disquisition on Karl Marx. He presents chapters on Marx as a prophet, sociologist, economist, and teacher. Putting them all together we obtain a sketch of Marx with a wonderful mix of scholarship in history and sociology combined with being a reasonably competent neo-Ricardian British economist adding a populist commentary, peppered with invective to produce a socio-politico-economic grand theory of society.

Unfortunately, as is indicated here, the fate of grand theories in the social sciences is that all of them fit as one of the quadrillions of plausible parallel worlds that all could coexist but cannot be proved to exist. Schumpeter himself, without many of the catch phrases and the diatribes comes close to adopting the grand theory approach of a socioeconomic dynamics. He foresaw a world

where large innovating international firms play a dominant and in part supra-national role; but in his concern with capitalism or socialism in the pre-computer and internet age, failed to see the profound changes implied in the closing of the world's open frontiers.

Setting grand theory aside, we have to face up to the specifics of key functions that national government policies as they exist can no longer provide unilaterally, they are:

1) international trade;
2) monies and credit;
3) immigration;
4) control of transmittable diseases:
5) famine, earthquakes, eruptions and other natural disasters;
6) drugs and international crime;
7) governance of the high seas, in particular and the biosphere in general; and
8) defense and terrorism.

The world is at a stage where international institutions can no longer be low budget symbolic appendages of nation states with little if any ceding of actual power. The League of Nations founded in 1920 and dissolved in 1946 was an organization designed to maintain world peace by both collective action and disarmament. Not only did the British and French draft proposals, a United States plan was drafted based on Woodrow Wilson's views; yet the isolationist view of the United State prevailed bolstered by the shelter from the weapons of the 1920s provided then by many thousands of miles of ocean and the United States did not join.

The headquarters of the League was selected as Geneva and it set up (among others) a Permanent Court of International Justice, the International Labor Organization, and the Health Organization. These institutions were eventually transferred to the United Nations along with other assets.

In retrospect the formation and functioning of the League of Nations, as powerless and ineffective as it has been portrayed may be considered as a valuable step in the operational recognition of the growing interconnectivity of the nations of the world and the need for various layers of international guidance

International Trade

In 2014, the sum of all GNPs was in US valuation around $78.28 trillion and the volume of world trade was around $19.08 trillion, not far from quarter of all trade (CIA, 2014). There are of the order of 200 countries in the world each with some variations in legal structures, accounting, conventions currencies and customs. The unification or, at least, standardization of the interpretations of the differences is of considerable importance to the functioning of international trade. Related to trade are the problems of standardization of weights and measures as well as legal problems involving the power relationships among both national governments and international firms. It appears that both regional and global agencies may be required to cover among other items, patents and trademarks, international theft of industrial secrets, oligopolistic behavior, corporate challenges to national sovereignty, tariffs, and restrictions on transportation.

Monies and Credit

Currently there are around 180 currencies in the world. A sampling of names among the largest countries or financial strongest includes the United States dollar, the Euro, the Japanese Yen, the Chinese Renminbi, Indian Rupee, Indonesian Rupiah, Brazilian Real, Russian Rouble, Nigerian Naira, Saudi Riyal, South Africa Rand, and Swiss Franc. The strategic political power bestowed by the ability of the nation state to manipulate its own paper currency is one of the basic factors central to the independence of the nation state. Institutions such as the Bank for International Settlements, the World Bank, and the International Monetary Fund have shown the progression in the last century of the growth of international financial institutions, each providing advice and aid to the nation state, but each extracting a loss of strategic power as all are required to conform with a growing set of international rules where default and loss of reputation with the cutting off of credit provide more policing than a police force.

The powers of individual central banks reached their peak sometime after World War II where international communication was still costly and controllable by the tax and financial authorities. Today the situation has changed considerably. Institutions like multi-celled organisms share powers and functions. When we consider the Federal Reserve System alone in the United states it deals with three layers of banks, the Central bank in Washington, the regional Federal Reserve banks and the commercial banks. If we consider that at each level a bank serves as not merely a money and credit manufacturing device but also has a critical role as a perception and evaluation mechanism that estimates the size and safety of the credit needs in a region then international governance may call for a world central bank, possibly with continental and regional central banks. The concerns with political freedom of the nation states and the economic freedom of central banks at different layers involve dropping the pretense that a concept such as an “optimal currency zone” is anything more than a political problem with some difficult technical economics design problems to satisfy the political constraints or to try show why the political requirements cannot be satisfied by economic reality.

Immigration

> Give me your tired, your poor,
> Your huddled masses yearning to breathe free,
> The wretched refuse of your teeming shore.
> Send these, the homeless, tempest-tossed, to me:
> I lift my lamp beside the golden door.
>
> — Emma Lazarus poem on the Statue of Liberty

In the 16th, 17th, and 18th and centuries the invading immigrants decimated the native inhabitants and in the 19th century the masses of immigrants provided cheap labor for the previously arrived. This was rationalized by the socio-psychological device of declaring the natives to be savages. The open frontier with the minor inconvenience of the natives existed in the Americas, Australia, New Zealand, parts of Africa, and Russia. Today all of the frontiers have gone.

The United Nations Commission on Population and Development provides data on international migration, among information on population trends, mortality, urbanization and other items. The International Migration Report 2013 indicated net immigration to North America during 2,000–2010 at around 1.3 million per annum and to Europe at 1.9 million per annum with net emigration from Latin America around 1.2 million per annum. India, Mexico, China, Bangladesh, Pakistan and the Philippines continued their net emigration; but due to the civil war a flood of emigrants from Syria has exceeded 4 million according to the estimates of the United Nations Refugee Agency press release of 9 July 2015.

Although the United Nations keeps track of refugee explosions from war and civil war zones such as Syria, Iraq and South Sudan it has hardly any ability to resettle them. As the borders close the world still staggers into next week under a scenario that has refugees loaded into unseaworthy ships sinking off the Sicilian or Greek coastlines with survivors helped or washed ashore to be taken care of by some form of *ad hoc* poorly funded and poorly synchronized international organization. Furthermore, regardless of immigration policy, world population is estimated[45] to head towards exceeding 10 billion soon after 2050 thus the pressures for active international population policy can be expected to grow.

In the world we live in world population growth is not yet high enough on any international agendum that the probability of active collaboration falls under the "Squeaky wheel rule. "The wheel that squeaks the loudest gets the grease". The refugee and immigration problems are squeaking louder than population control.

Transmittable diseases

Transmittable diseases have been present well before the existence of *homo sapiens*. With the enormous growth of international trade and human mobility it is evident to all that communicable disease will travel everywhere and an outbreak of Ebola in Sierra Leone represents a challenge to all, not merely to the locals. One of the more effective international organizations has been the World Health Organization. It serves as an example of where a sufficient recognition and correlation of national interests has provided for the evolution and strengthening of an international organization.

Famine, earthquakes, and eruptions

In the modern world the prime causes of deadly famine have to be political and economic. The technology of food storage and transportation are such that international action can ameliorate any famine if the political and economic forces do not oppose the amelioration.

So called "Acts of God" such as major earthquakes, eruptions, or being hit by a meteor may be short duration intense disasters that require international aid by all, if only for humanitarian reasons.[46] Even without formal special international institutions international reaction to major earthquakes and volcanic explosions has tended to be fast and reasonably effective.

Drugs and international crime

The attempts of national and international control of drug trade and crime do not appear to be particularly successful. The agencies include the United Nations Office on Drugs and Crime and the Interpol, The World Health Organization, and other national agencies. The profitability of the narcotics trade is too large to make it easy to contain by organizations with a fraction of its budget. This raises the economic question as to whether or not it might be more fruitful to legalize many drugs and control the industry at the individual country level or even a finer local political subdivision level. The United States experience with the prohibition of alcoholic beverages provides a case in point.

Governance of the high seas and the biosphere in general

As pollution increases, acidity of parts of the sea change with human activity. Exploration of the depths increase and possibilities for mining grow so does the need for international law and enforceable governance, this includes the laws concerning the building and claiming of artificial islands. Furthermore as human ability to change the composition of the atmosphere is now recognized debate on the definition of the biosphere and the level of international control is now called for. There is a UNESCO Man and Biosphere Program, but little international infrastructure appears to exist.

Defense and terrorism

In general defense, the threat of nuclear war is a Sword of Damocles that constantly threatens the world. A supranational agency with general powers of inspection in every nation state with no exception is called for. Furthermore the power for enforcement is needed to control weapons of mass destruction. This emphatically does not require a reduction of atomic bomb stockpiles to zero (see Bracken and Shubik ,1993), but if nuclear war is to be averted there must be weapons reduction, full inspection and international enforcement.

The problems imposed by the growth of terrorism are different from the utilization of weapons of mass destruction by the nation state; but they are linked to the changes in lethality of all weaponry in last 150 years[47]. It has been many orders of magnitude over all preceding history (Shubik, 1997). Not only has general lethality increased, but in particular the basic lethality and communications and organizational abilities of a small terrorist group have increased even more. In particular the damage exchange rate between a small group willing to take some casualties, such as suicide bombers against a nation state has increased by orders of magnitude. Items such as airport security must take into account passenger hours lost in inspections as well as any physical damage. Even a reasonable cursory treatment of this topic would require an unduly lengthy diversion into military operations research and is not appropriate to this book beyond making the observation that this topic is high on any list concerning the need for the growth of an international policing system with resources and a supranational mandate. Furthermore in every nation state as they exist currently, the need for protection against terrorism provides a perfect instrument for the demagogue who promises non-existent or fraudulent cures often based on totalitarian means that would destroy the liberties that they are meant to protect. A democratic

state in contrast with a totalitarian state faces a double jeopardy. It not only is unable to use illegal totalitarian means to combat the terrorists, it also has to protect the civil rights of the snake oil salesman and the would-be dictators who wrap themselves around the flag while trying to destroy the values that the symbol stands for.

International institutions with power

In spite of the comments of the ineffectiveness of the United Nations, this institution represents a considerable step forward over the League of Nations and provides the institutional matrix from which the next growth and improvement in resources, power and effectiveness of the emerging institutions for the governance of a fully integrated one world with no open frontiers left, but space itself.

Good enough, or perfection: Behavior and reality

It is easy to criticize a popular belief, but difficult to replace it with something better. This is especially true when the problems are complex and the elixirs on the right or left are sold by the salesmen who instinctively understand and even believe in the wonders of instant gratification. An abundance of **pie in the sky** is, in general, attractive to most of the public most of the time. The ideal pie is never served as uncompromising rhetoric fails to match complex reality.

In a period of extreme stress such as a war or a deep depression rhetoric may have its place. The oratory of “Blood, Sweat and Tears” can stiffen the resolve of a democracy and coordinate behavior. On the other side of the ledger the ranting in a Nazi Nuremberg rally can increase the malevolence of a dictatorial state. A boost in morale is a valuable but may be a fast depreciating asset. Since Plato the dangers of oratory have been recognized. The tradeoffs between passion, general promises and a deliverable policy remain unresolved.

The comments above are aimed at the noneconomic context of our society that must be addressed and fixed sufficiently to enable the economic guidance mechanism of the economy to function well. Any economist worth her salt knows that the human has passions and that in war, politics and social interaction the crude simplification of the passionless economic optimizer does not hold. Inspiration and hope are magic and needed to promote a productive economic policy. Decent administration, good logistics and well-designed laws provide the path from wonderful pie in the sky to acceptable bread on the plate.

Any sane citizen tires of having to fill in incessant forms, especially if they project or symbolize Big Brother. But simplicity has its costs. An inmate on a chain gang has a secure job and little paperwork. A small business owner or investor may find the compliance to interminable paperwork worse than the taxes being paid. Yet there is a general truth that when there is freedom of choice all human behavior is constrained by its environment. An analogy can be supplied from one of the key almost invisible infrastructures in a modern society. The delivery system for water has always been a key element in the growth of civilization. It depends on a vast network of pipes, pumps, dams, catchments, filters and other equipment. When functioning well it is almost totally invisible. Most of the time we take its seamless guidance of the flows of

water for granted. Society still regulates water at many different levels but in many places with considerable implicit consensus. A basic challenge is to provide the same for a banking system and a police system among others.

An aside on Milton Friedman

We now return to more strictly economic and organizational problems and to economic advice.

> The owl was the wisest animal in the forest. He held court to give advice. A humble centipede appeared before him asking how to cure his 100 sore feet. The owl said wisely "For the next two weeks walk one inch above the ground. There will be no pressure on your feet and the air circulating under them will help with the healing." The centipede thanked him, but had the temerity to ask how he was going to be able to walk as recommended. The owl replied "I have solved your conceptual problem, do not bother me with technical details".

Milton Friedman, his wife Rose, his acolytes, and mentors at Chicago have offered us a wonderful world in which the market cures all with minor adjustments. This is all based on the premise that all of the misnamed liberals on the left are really socialists and believe in the perfection of man and big government. In contrast the real liberals now called conservatives know that man is far from perfect but know that all markets can be made perfect with little work.

Unfortunately when the rhetoric is discounted the message against big government and the virtues of the competitive markets are clear to many economists, but the fixes are more or less at the level of the wise owl noted above. We are offered the "one shoe fits all" solution.

It is suggested here that the basic economic problems are not only far more complex and institutional than presented by Friedman, and colleagues, but they failed to appreciate the basic evolutionary dynamics that the economics of competition calls for. Schumpeter and Keynes understood that the evolutionary competitive world was one with dynamic disequilibrium. A world where the graveyard of pure equilibrium, is never attained. A world where one can judge the system as healthy exists when most large firms exist with a backlog of law suits outstanding, where they win some and lose some, and as they progress these suits are replaced by others.

Further policy considerations

Beyond the candidates suggested for international agencies with the power of enforcement there are other specifics of a more economic organizational aspect that need fixing.

Bureaucracy and responsibility taking

As the work in economic theory has progressed the subdivisions dealing with contracts, with the design of incentive systems, with non-symmetric information and with team theory have all taken up various aspects of how can one coordinate in an optimal manner the actions and interactions of many individuals in a formal organization. Even relatively simple structures do not yield easily to formal mathematics; but attempts to build the models often uncover perverse

incentives that require correction regardless of the social-psychology of the organization. However the socio-psychological and sociological aspects of organization cannot be ignored by any individual concerned with the understanding of organizational dynamics. A crude back of the envelope calculation suggests that a fully employed individual who works 8 hours a day from the age of 20 to 65 devotes of the order of 15%[48] of his or her waking hours of all life or around 27% of employment life. These numbers are large enough slices of personal existence that the sociology and the socio-psychological aspects of the organization have to matter to the individual. These include interpersonal likes and dislikes, such as having to deal with a local boss who has it in for you because your regional vice-president is impressed by you; the pressures of competition among several for the one promotion available; the problems in dealing with being passed over; the overweening ambition of a colleague who would sacrifice his best friend once he was no longer useful to his trajectory. All of these are not in the domain of the pure economic theorist, although the dream to quantify the passions is both there and organizational behavior research is a desirable and possibly fundable scientific endeavor. Here, three items are suggested that derive from the thoughts in modern economic theory, in social psychology and in sociology. They are **responsibility, individual accountability** and **transparency**. Each of these in principle, is simple, but in practice is highly complex.

It has been suggested that an individual in the late teens or early twenties who is socially conscious sees many matters in terms of black and white. The idealistic principles stand out loud and clear and one can go to the barricades with a clear conscience. In the late twenties and possibly for the next 30–40 years the nuances and the lack of clarity in bringing about the practice of the principles begin to crowd in, and if the individual does not turn into a complete cynic, the principles run the danger of becoming coming grey and relativistic. At the age of around 60–70 the relativism may subside, principles may appear again, but with the understanding that although they may stand in the theory, in the practice they are there but with an array of *ad hoc* qualifications and law cases attached.

In institutions with over a few hundred people the necessities of control and organization call for job descriptions that more or less describe the basic duties and responsibilities of all direct employees of the organization. Size forces anonymity on most employees except for their direct and frequent connections inside and out of the organization. The customers tend to know no one at any of the service providers they use, be they supermarkets, water companies, power companies, communication companies. When they need service they fight their way through a maze of automated numbers and telephone queues with some human fall back for the hardy and/or technically incompetent. Sometimes they may actually obtain the name of the operator they are talking with in Omaha or Bangalore. At this time the predominant belief is that mass service is helped to be efficient through mass anonymity. A strong case can be made for much of this anonymity, but a different view of the nature of aggregation and organization suggests that possibly more economically designed organizations and a better served society can be obtained by concentrating on removing some aspects of the non-symmetry between the individual and the anonymous organization. This calls for the removal of all anonymity in transactions by the inclusion of at least the specific name and direct means of communication with the prime **responsibility-taker** for the communication at hand and the availability of the specific names

and direct communication information for any designated assistants. The responsibility-taker should be exposed to being sued separately from the organization.

Four specific examples are noted here to help provide context:

1) the bank charges for an incorrectly attributed insufficient funds;
2) the IRS or other tax authority incorrectly handles a tax payment;
3) a retailer of any sort delivers a flawed product; and
4) An issuer of a mortgage backed security faces payment problems.

Currently when a payment is marked insufficient funds, at the least the bank charges a fee such as $25; but when it turns out that the insufficient funds treatment was inaccurately assigned no satisfactory formal process for restitution and payments for the damage done to the customer appears to be universally applied. The cure is **symmetric redress** with restitution to the customer including payments of administrative costs incurred by the customer for verifiable time costs beyond some reasonable bound.

Every IRS document would require a named suable individual and a named individual required to respond directly to phone or E-mail within a specified limited time. As with the bank all penalties would be symmetric.

All products must have a named final approver liable to being sued and as above a named responder with compensation paid to the customer for time spent seeking redress beyond some reasonable minimal bound.

A mortgage backed security is a complex synthetic financial instrument where a large group of mortgages are purchased from the original issuers and then evaluated by the new owner and cut into many pieces, say 5 or 10 where each piece known as a tranche has different risk characteristics, the top tranche consisting of those mortgages that are assessed the smallest risk of defaulting and the bottom tranche contains the riskiest mortgages. Who should share risk and responsibility in their issue if errors are made such as poor documentation and bad assignment of risk? This is beyond a simplistic discussion, but the principles concerning transparency, responsibility and redress are still completely relevant.

No attempt is made here to provide the ad hoc details that apply to all. The underlying principles are basic responsibility-taking, the personalizing of communication and symmetry of treatment between the institution and the individual by requiring the attachment of names to the bureaucracy.

In all institutions the rules concerning dismissal of individuals are institutionally complex and cannot be changed with ease, but the suggestion is that the conventions and rules concerning dismissal be impacted by the performance of each responsibility-taker.

Transparency and the costs of investigation

The power to delay is one of the great negative powers that is present within any bureaucracy. In

any bureaucracy one of the top means to introduce delays is to withhold or distort private information. A classical example is where this possibility appears in a loosely centralized structure where a central agency[49] is in control of budgets but is not actively informed of the needs of the subunits that are required to submit their budgets to the central agency. Each subunit knows its needs and has better information on the needs of like units than does the central agency. The central agency knows that it does not know; but could carry out a costly investigation of some or even all of the subunits. It has to consider how to design an optimal inspection strategy. The subunits know this and each has to design a strategy that give them the best expected payoff taking into account what they will gain if not inspected and what they will lose if inspected and found to be padding the budget.

This type of problem is always with us but the potential for dysfunction is lessened with a stress on prompt disclosure and transparency.

A Federal Employment Reserve Agency: A practical proposal

In the longer run in society survival and peace are top priorities, but in the shorter run **full employment and efficient production** in the economy is dominant. A healthy economy is one that does not waste its real resources of goods and labor. Private finance undoubtedly may aid in structuring production plans; but coordination with public finance and the existence and acceptance of sociopolitical will and purpose are required to act in a timely manner.

Enterprise is fostered by understood and accepted rules of the game, and the rules do not appear by magic or markets. They require the development and enforcement of items such as an accounting system, bankruptcy and default laws, a commercial code and contract law. When the system is under stress fail-safe measures must be adopted.

In the day by day operation of the institutions of a dynamic economy the formulation, legislation and the enforcement of rules to set the environment for the functioning of a successful enterprise economy are critical. The process is a difficult ongoing evolutionary process produced by fallible and self-centered human beings.

The ideologues of both the right and left imagine Utopian scenarios either with no government or with an ideal government. Neither of these states has, nor ever will exist, except in political rhetoric aimed at entrapping the unwary. Reality and “good enough” economic efficiency resides not only in building the institutions and laws that provide the rules of the game but in answering the question: “Can they be implemented successfully at a reasonable cost?”

Political, bureaucratic and social forces manifested in the 1913 Act created the Federal Reserve System. This institution has been evolving and adjusting over a century and continues to do so.

In spite of populist attacks since the founding of the United States one of the more successful governmental economic institutions in the United States has been the Federal Reserve. It has manifested a desirable blend of public and private forces. It is clearly sensitive to both local and global concerns in the country. Unfortunately the Federal Reserve and the Treasury are not

enough to manage the national money supply in a multistate world. Nor are they immune to the powers of fiscal policy.

There are occasions where the financial control mechanisms of a society are not sufficient to stop serious damage to the underlying basic economy they are meant to protect. When this happens the system requires a fail-safe mechanism that comes into play when the financial brakes do not work. Such a mechanism in the form of a Federal Reserve Employment Authority that is designed to coordinate and meld monetary and fiscal emergency policies is proposed and discussed below.

Our financial institutions and instruments are part of an overall guidance and control system for the political-economy. The structure has to match the supply of public goods and taxation with the demands of the electorate and the pressures on international policies. This calls for a blend of economic, bureaucratic, and political forces that like the Federal Reserve Banking system has an organization structure that is laden with checks and balances and with diverse interests represented.

The Board of Governors is appointed by the President and requires confirmation by the Senate. Like the Supreme Court the Board of Governors is the product of the interplay of political, economic and legal forces. The number of governors to be selected reflects judgment calls on the balancing of powers and the ability of the institution to function.

It is suggested here that for the goal of keeping an appropriate socially acceptable index of unemployment below some specified level, a government agency similar in power and structure to the Federal Reserve System would be appropriate. Such an institution, The Federal Employment Reserve Authority (FERA) would require considerable hand-tailoring to provide the appropriate control details needed. But it could provide a permanent institution that would be an improvement over any last minute disaster crash program such as the temporary WPA program utilized by the Roosevelt administration during the Great Depression.

In the design of an institution aimed at ameliorating the level of unemployment it is highly probable that we need to hand-tailor a control structure with governance numbers different from either the Supreme Court or the Federal Reserve in order to fit the United States of the twenty first century.

NAIRU or the Non-Accelerating Inflation Rate of Unemployment is a product of the institutions, laws customs and technology of each society at a particular time. An institution such as a Federal Employment Reserve Authority would be devoted to monitoring the “natural rate of unemployment” which is natural in the sense that it is dependent on the current institutions, laws, customs and technology.

A sketch of a few features of such an establishment is included. The Federal Reserve System has of the order of 25,000 employees and 12 district banks. Instead of 12 district banks and a central bank, the proposed new institution most naturally calls for a central coordinating authority in Washington and 50 branches, one in each state. A first cut at bounds on its size would be of the

order of 6,000–11,000 **employees, and a board** of governors split among business and labor representatives from the state, as well as academics and Federal and State representatives.

Each authority would be required to monitor constantly the unemployment levels in its state. It would also generate and maintain a listing of potential public good or other desirable infrastructure projects with priorities and potential revenue generation possibilities. The stress in priorities would be on self liquidating projects where some portion of the revenues would flow back to the state and, or the federal government.

A new **Joint Assessment Financing Board (JAFB)** would be required for interfacing and coordinating among the Federal Reserve System, the Treasury and the **Federal Employment Reserve Authority**

The duties of this board would be to monitor constantly the listing, evaluation, financing and projected paybacks of projects-in-reserve proposed by each regional branch so that the structure of the financing can be set in place as soon as the employment level in any region passes the trigger value. A further duty of this board would be to determine how the unemployment in the state breaks down into recession unemployment or technological unemployment or other special categories.

It is important to stress that constant monitoring and the ability to act quickly and deliberately is required. This also requires that legislation be passed in advance to provide sufficient flexibility in emergency financing without having to go to Congress or state legislatures to trigger action. Prior authorization is critical to avoid potentially critical delays.

Technological unemployment should not call for Agency action except via an **Educational Retraining Board (ERB)** acting in concert with the educational resources of the state and the Federal Department of Education.

The regional branches of the FERA would employ of the order of 100–200 individuals. The governors would be selected from state government, the public and top local employers, unions and professionals in the region.

The Board of Governors would be responsible for developing State and Federal taxation and funding guidelines in concert with the Federal Reserve System via the Joint Assessment Financing Board (JAFB).

The Regional Authority and member firms would be responsible for the generation, maintenance and transparency of micro information on the state of unemployment, the valuation of local projects worthy of sponsorship in a high unemployment environment, and the distinction between recession, technological and other unemployment.

There are several basic principles that should be adhered to by the Authority.

It should never own assets that it does not have the in-house capability to evaluate. It should avoid supervision of projects where it does not have sufficient in-house expertise.

Its role is to coordinate and stimulate activities promoting employment, not to employ individuals directly. Only under conditions of deep depression a direct WPA employment approach might be permitted as an act of last resort.

The Authority must stress transparency in the availability of its information sources, evaluation of the regional economic and employment status as well as the projects to be implemented and the bidding and procurement procedures employed. Legal redress and resolution rules are required in particular to avoid external blocking tactics.

Once unemployment goes above a fixed level, say 5 or 6% (to be adjusted by circumstances) the Authority would put out bids for projects in coordination with Federal and State funding authorities for the means for financing.

The above comments are to be interpreted as a rough sketch providing an overall outline in principle, not as a detailed blueprint. There are many details to be worked out. The drafting of institutional rules is an evolutionary process. But this overview is offered as a start at building and institutionalizing a fail-safe system for the economy when the financial control structure fails the real economy. It stresses guidance and pre-planned coordination, not prediction.

The outline is based on the United States economy, but beyond local macroeconomic details and conformity to custom the principles should hold for any economy where the compromise between the powers of government and a stress on individual local choice is of importance. It is designed for a loosely coupled system.

Reconciling monetary and employment policies. In any static analysis is clear that monetary and fiscal policies can and do clash. But they are both needed and the goals of no to low inflation and lender of last resort for the Federal Reserve must conflict with varying intensity with the employment goals and fiscal plans of the suggested FERA. In the dynamics, however an accommodation between what should be two independent agencies with different central goals is called for. All planning, corporate or governmental is iterative. Five to ten year is just about the furthest out that plans for most business and politico-economic purposes can and should go. If they are done well, they can and should be updated at least annually.

There is a more or less natural order of importance in taking care of the functioning of the economy. Avoidance of a dramatic crash is usually at the head of the list. It is here where Bagehot's Lender of Last Resort (LOLR) plays its critical role. Its effectiveness is improved considerably by the branches of the commercial banking system having done their homework in evaluation of real assets. The actions of the central bank, in order to have the full flexibility needed also need to include the appropriate actions with the national debt, which institutionally may or not be strategically separate from the central bank.

Given the avoidance of any basic crises it is still quite feasible that a high unemployment, or even negative growth economy exists. It is here where a FERA is critical.

Milton Friedman's suggested policy for a more or less automatic growth of the money supply of a few percent per annum is a realistic recognition of the approximate relationship between

money and trade in a growing economy, but is not a policy that either protects against dangers or promotes full employment.

Adam Smith gave us the key insight on the production of wealth via the division of labor. Commodity money, fiat money and banking grew as emergent properties needed for efficient trade. Alexander Hamilton understood the key uses of the central bank and the national debt as control and coordination devices in an economy and Bagehot enunciated clearly the central precept on how to control a crisis. His rule of lend freely at a high rate of interest on good security holds today even though buried somewhat in complexities and obfuscations brought about by the multitude of specially designed derivative instruments.

On top of these the FERA proposal is aimed at adding the extra ingredients for the information and coordination of flexible reaction to unemployment.

My colleague and friend at the Cowles Foundation Robert Shiller has pointed out to me recently that the Roosevelt administration considered the formation of what he called the Public Work Reserve. This is much in the same spirit as my suggestion unfortunately the Public Work Reserve was not institutionalized permanently.

Trade, money finance, and competition

The basic purpose of my essays is essentially complete with this end of Chapter 12. World prosperity increases with specialization, as does complexity and the volume of world trade. Finer measurements are obtained and quantification expands. Most of the basic physical needs of humans can be and are supplied by markets. Potential market failures can be ameliorated by judicious adjustments of the rules supplied by government. Many of the political, social, aesthetic and religious beliefs and desires cannot be supplied by the markets; although many of the resources needed to achieve them can be supplied by markets.

The facilitators that can make world prosperity feasible are the nations in collaboration in the construction of international law and institutions in coordination with local laws and the joint adherence to and enforcement of international law. The roles of local and higher governments are to provide the governance, resources and the cascade of constraints needed to support the functions that previously could be regarded as local or at most national by world rules.

The facilitators of markets are monies, credit and financial institutions. There are no logical and few, if any, technological reasons for a single world currency. The concept of an economically optimal currency zone is a snare promoted by those who fail to distinguish between basic economic problems and the surrender of national political powers. There are no logical reasons against any political entity having several near-monies to provide local flexibility. There are many technological problems with the creation of safe and low set up cost credit instruments. Fortunately the profit incentive is considerable in improving the transactions technology. Unfortunately when we consider economic dynamics the solution to the control of politico-economic fluctuations still eludes us somewhat.

At the risk of sounding like Pollyanna, the growth of both theory and practice in economics and finance has been considerable, and at least our understanding of mass markets combined with the development of econometrics and experimental gaming provide for an emerging economic science.

The comments above are based on the hope that we can minimize the use of many of the ways involving force that have been used to allocate resources. In a Utopia war, illegitimate force, fraud, deceit, and theft do not exist. In a Dystopia they are there. I suggest that the world we have is what I call a Myopia, a world in which many unpleasantries exist; but their existence is played down and we hope that they are more or less under control. We manage to make it to next year by actively ignoring much of the gathering gloom and, at least so far we have done so without total disaster. The signals are clear we can muddle through by letting the nation states evolve into more complex entities where control over major international and world problems are ceded to world organizations along with the power f enforcement , while inasmuch as is possible local concerns are handled by local governance. The nation state *per se* does not necessarily disappear, it merely transmutes into being part of a more complex structure where functions such as defense and pollution control that were only national but are now one world problems imposed on us by the changes in technology and the growth of population. The transformation will not be linear. Items such as the British Brexit will take place. The naïve simplicity of free trade is not amenable to simplistic solutions and the laws and institutions have not yet been built that guide an equitable international trade.

The last chapter may be regarded as an add-on or afterword and deals with the potentially dystopian environments in the future and some glimmerings of what might be done to cope with them.

Chapter 13

Political economy, the future dystopias, and space?

The human species like other animals on the food chain began in competition for resources. As it grew in sophistication and organization it was able to apply its ability to kill other species and its own more and more efficiently. It is now at its peak in its ability to kill and is still increasing its abilities with little indication that there have been individual changes that have modified the instincts for aggression. It is by no means axiomatic that humans or any other mammals can be expected to last more than a couple of hundred thousand years.

Thinking about the unthinkable and calculating the incalculable

In the innocent days of 1960, Herman Kahn, a member of the Physics group at RAND, wrote a lengthy book *On Thermonuclear War*. He left RAND to form the Hudson Institute and some years later, in the 1980s he wrote *Thinking about the Unthinkable*. Herman loved to shock individuals; he would stand at the intersection of two corridors at RAND looking like a portly rhino and hold court. He had the rigorous training of a physicist combined with a talking speed of an auctioneer and, when warmed up to the topic, the hyperbole of a carnival shill. He liked to and succeeded in rocking the boat. In the context of those days many things he said were shocking. Today many of them are old hat.

Dr. Strangelove was billed as `How I Learned to Stop Worrying and Love the Bomb.' Few of us have learned to love the bomb, but most of us go about our day to day lives and give little thought about it. A basic difference between then and now is that many matters that were shocking then have become worse but are accepted implicitly as part of living in interesting times.

I suggest that the time has arrived to not merely think the unthinkable about space but to start to calculate or recalculate items that belonged to early optimists or science fiction writers yesterday but are part of the reality of the humdrum logistics of tomorrow, such as the cost per kilo of sending equipment to the moon.

The end of intelligent life?

Three scenarios among many others[50] are considered and accepted or rejected for bringing about the end of intelligent life: (1) A third world war; (2) An irreparable level of pollution or climate change; and (3) A cataclysmic meteor collision.

In 2015 the nuclear defense triad still exists with hidden land based missiles , air patrols with nuclear bomb armed aircraft and the seas patrolled by nuclear submarines of several nations with more than enough firepower to obliterate every large city in the world, most of us give lip to the dangers of nuclear war in reaction to the occasional article in the press but most of the time we live our lives as though a third world war is hardly worth thinking about. Given that there is little that a single citizen can do, this is completely consistent with individualistic local rational or

habitual behavior.

To some of us, the miracle of the post-second World War is not how bad matters are, but how good they are. We have had 70 years without a nuclear war. The Bulletin of Atomic Scientists, a currently online publication that for 70 years has attempted to spread information to the public about the dangers of nuclear war has been setting a Doomsday clock yearly giving their estimates of the current danger level for the occurrence of disaster. It has been set over the years since 1945 at between 17 minutes and 2 minutes to midnight. The 2016 setting is at 3 minutes to midnight. It now includes not only nuclear disaster, but also other potential disasters such as climate.

A consideration of major wars through history indicates that although casualties have been increasing the percentage of world population killed has not increased. Even crude estimates of casualties in a future nuclear war are difficult to find or make an educated guess. My own crude guesstimate is of between 300 million to 900 million immediate casualties, even throwing in a gross overestimate of an extra 50% long range radiation deaths (far larger than the Hiroshima, Nagasaki estimates) and the un-inhabitability of large tracts of land for several decades still gives little if any indication that the war could succeed in wiping out humanity. This is still well under 30% of the world's population.

When we consider pollution and climate change or any event that encompasses the whole atmosphere, the prospects for the annihilation of the species become far more real.[51]

We have reached the point in scientific development where we understand how to obtain reasonable estimates on the number of potentially inhabitable planets in space, and we have sent messages into space; but to date we have not decoded any evidence of messages from other sources. There are many hypotheses we can dream up, all of which fit the current evidence. These include the religiously oriented belief that humanity is unique. Another hypothesis is that it will still take many years before we can expect to receive and verify any message emanating from an apparently intelligent source in space. The hypothesis that I suggest is that there may have been many planets that have produced intelligent life forms, but when the level of intelligence reached ours, they developed science and technology as we have, and like us their abilities to control the forces they had released was weak and eventually within the equivalent of 100–200 earth years they destroyed themselves possibly in major wars but more likely with irreparable pollution.

It is unlikely that all individuals in a future war will be wiped out immediately but the recovery to the level of current civilization may fail or take considerable time if the destruction of the infrastructure is high enough. If the probability of self- destruction were not high, one would have to consider the possibility of existence of many civilizations with far superior science and technology to ours, in which case now that our technology is up to receiving messages from superior civilizations we should have heard from them, even though they might have died after the message was sent.

The third possibility for destruction suggested is that a meteor of larger than, say 2 kilometers in radius were to hit the earth. This would essentially obliterate all life. This is a sufficiently low probability event that few resources are being spent on it beyond some thought about whether asteroids can be predicted early enough and deflected from a collision course. These items raise basic questions concerning the allocation of resources to highly dangerous but low probability events. Some thought has been given to this.[52]

Archives on the Moon

Given the history of innovation and its relation with war and, in spite of the popular myth of the trail blazing private entrepreneur it appears that the use of war or threat of war has served as a coordinating device to enable governments to sponsor the early basic research on many innovations that were subsequently developed and commercialized by the private sector.

I suggest that the probability of a new world war within the next 30 years is extremely high; and it is in the self-interest of most nation states to try to avoid this potential disaster. Any Cassandra has the strange task of making a prediction in the optimistic hope that her contingent prediction is acted on in such a way as to be falsified, leaving skeptical surviving politicians feeling that they have been hornswoggled into authorizing resources on a counter-factual warning.

There appear to be several actions that can promote innovation and cut down on the possibility of war and its damage by offering a substitute device for channeling military competition and capturing national cohesion as well as providing insurance that reduces recovery time should a major war break out. They include a space race and the construction of human civilization archive storages on the moon.

At this early stage in the construction of the many layers of international, continental and more local special purpose governing institutions few international agencies have any direct power of enforcement. They thus may serve as inhibiting devices, doing nothing, but doing it in a diplomatic way. A plausible reason why there is no regular moon shuttle after the first landing of humans in 1969 is because weak international cooperation allows all parties to pay lip service to development but to do nothing, with the comfort of knowing that others will join them in inaction.

I advocate a unilateral declaration of intent by the United States to construct at least one nonmilitary observation station, commercial exploitation base and archives on the moon. I believe that such an act could promote a mixed noncooperative but eventually cooperative international moon race that would serve as a major coordinating device in the economies of many countries and provide an outlet for many of the implicit and explicit pressures towards aggression caused by the ending of open frontiers on earth.

The construction of archives on the moon has three purposes. First it provides insurance in helping to rebuild civilization after World War III, and second it probably delays or even avoids World War III. The third reason is by stressing the development of techniques for building sustainable inhabitations on the moon many applications pertaining to inhabiting other planets

will be developed. Much of this work is a natural preliminary to building on Mars.[53]

A unilateral declaration of intent by the United States or, possibly China should be sufficient to provoke international action. International cooperation may be desirable, but may need independent action to launch activity if joint action is not forthcoming. In particular it provides a major coordinating device in the economies of many countries for spurring innovation.

Whatever the complex purposes attributed to any civilization may be, survival is a *sine qua non.*

The construction of a moon station has been considered at the level of engineering and design since at least the 1960s. A nontechnical overview with many references is given in a Wikipedia article entitled Colonization of the Moon. There are many technical, social and political problems involving a moon colony: (1) the construction and location of habitations; (2) transportation on the moon surface; (3) regular and economic transportation between the Earth and Moon for both cargo and individuals; (4) economic exploitation; (5) the worth of an astronomical observatory on the moon; (6) archives on the moon as insurance; (7) medical and socio-psychological research; (8) innovation spin-offs; and (9) political governance.

Looking at this list individually one can quickly see that items (1), (2), and (3) rest heavily on problems in hard science and engineering with feasibility first then cost considerations. Economic exploitation (4) calls for considering the use or resources there for moon development uses as contrasted with exports with considerable transportation costs. An astronomical observatory (5) has to be evaluated in contrast with a space station observatory; the worth of innovation spin-offs (8) and trickle down has always been extremely hard to evaluate; medical and socio-psychological research (7) may be regarded as a frivolous expenditure if the same money could be spent on cancer or some other favorite disease of the congressional committee needed to sign off. Even a tyro politician should be able to muster an array of objective experts on either side to kill or promote a moon development program. A call to action is not in the domain of economics or accounting, it lies within the perceptions and imperatives of social process and survival.

Per ardua ad astra

The title “From adversity to the stars” was the motto of the Commonwealth air forces during World War II. It is apposite in ending this chapter concerned with the future. Deep fundamental changes have taken place in the world of today from the worlds that existed before, when almost all of the economists noted here were writing. In particular, for better or for worse, we live in **one world.** On Earth the open frontier no longer exists. The **only open frontier is space.** The `animal spirits’ of humans still exist. The hunter and warrior of prehistory and history are still here. Until these aspects of humans are better controlled and coordinated, given current technology, communications, computation and weaponry the availability of an open frontier is a highly desirable device to help remove the pressures and move current self-destructive activities into the future where the disequilibrium processes of evolution will resolve them.

Appendix A

Preferences and Utility

All one needed was the ability for individuals to make comparisons of preference between any two items, and have a transitive preference ordering over any bundle of goods being offered. Transitivity merely states that given three items *A*, *B*, and *C* if *A* is preferred to *B* and *B* to *C* then *A* is also preferred to *C*. This is an assumption that may hold for brown bread, bagels and baguettes, but is by no means a general property of all goods; but it seems to be not too bad a description for many consumer goods. The great applied mathematician von Neumann pointed out that if uncertainty were present in the economy (and it almost always is) one more highly plausible assumption was sufficient to establish the proof of the existence of a utility function including the individual's reaction to risk. The assumption states that if *A* is preferred to *B* and *B* to *C* there should be some gamble or lottery ticket such that if one is offered the lottery ticket that pays off with A with a probability *p* and pays off with *C* with a probability $(1 - p)$ one should be able to find a value of *p* (where $0 \leq p \leq 1$) such that an individual is indifferent between taking the risk on *A* or *C* or taking *B* that is a sure thing.[54] Almost all of modern finance has been built up on the idea of economic choice made under risk and the empirical observation that most people most of the time are risk averse. There are some risk lovers, who even enjoy defying death, as a sport; others who enjoy buying lottery tickets as a fling with Lady Luck, while simultaneously buying insurance to protect their homes. Context may influence individuals to take risks in one setting while being risk averse in another.

Although the theory is elegant, the empirical evidence on how individuals actually behave is still very much an open question.

Appendix B

The Basic Game Theory Concepts of Use Here

The development of the theory of games enabled us to give precision and clarity to many aspects of competition and cooperation that appeared to be non-quantifiable. In particular a mathematical language was developed that offered a deep understanding of words such as: choices, moves, information, common knowledge, strategies. In this small book we do not need most of the formalities and can cut corners, but the concept of a zero sum game and a nonzero sum game and the formal understanding of the differences between cooperative and noncooperative games and the importance of three solutions, the core, the value and the noncooperative equilibrium all merit understanding.

B.1. Details, strategies, and diplomacy

There are three formal representations of any game. They are: (1) the extensive form, (2) the strategic or normal or matrix form, and (3) the cooperative form.

The extensive form provides a language for the description of a game in complete detail including a way to show who knows what, when. It lays out details move by move and shows the full sequence of actions through time. As we do not utilize its details here and they are highly technical we do not cover this development.

The strategic form is used primarily with the noncooperative solution defined below. It views the game in terms of a set of strategies and payoffs for each player. Call a representative player *i*, he has a set of strategies S^i. We denote a particular strategy *j* by the symbol s_j^i. We also associate with each player *i* a payoff function P^i. If there are *n* players in the game this function depends on *n* variables and can be expressed as $P^i(s_j^1, s_j^2, ..., s_j^n)$. The complete game is described by (*S*,*P*,*n*) or the number of players and the set of all strategies and payoffs for each player. The strategic form offers an overview or synopsis of the more detailed extensive form.

The cooperative form calls for a further boiling down of the bare essentials of the detailed game to the sort of detail that can be best handled by the diplomats or bargainers or dealmakers. Viewing the three representations together, the first has all the detail down to minute tactics, the second can be viewed as the boiled down for the general or overall manager who needs to develop and overall plan of action. The third is for the owners, directors or government above the generals or general managers. Final governance is concerned with ultimate goals, power and negotiation with others based on their potential strength. This is reflected in the **characteristic function** of a game in cooperative form. The characteristic function is a set function where for a game with *n* players it takes in 2^n values, a single number for each of the coalitions showing what that coalition could achieve if it acted alone. The game in cooperative form is described by the characteristic function and the number of players denoted by (*v*,*n*).

B.2. Zero-sum or Nonzero Sum?

The distinction between a zero-sum and a nonzero sum game is that in a zero sum game the group of the players as a whole has nothing to gain. An example of such a game is a Poker game. Although it is illegal, it can and has been played with some subgroups cooperating secretly. The actions of the game may redistribute the wealth, but do not change its amount. This is reflected in the characteristic function where the equation

$v(S) + v(N - S) = 0$

reads as the value of any coalition S plus the value of the complementary coalition $N - S$ sum to zero.

In general, the economy and polity have the property of being wealth creators, thus

$v(N) \geq v(S) + v(N - S)$

which reads as the value of the social whole is greater than or equal to the sum of the parts.

B.3. Solutions

The game represented in extensive form is used to study dynamic solutions concerning teaching and learning under all types of information. There is no professional consensus on a ruling theory.

Noncooperative Equilibrium

The noncooperative equilibrium is the solution to the set of simultaneous equations

$$Max_{s_j^i} P^i(s_j^1, s_j^2, ..., s_j^n)$$

$$\text{for all players } i$$

Each agent acts independently, but at equilibrium no further individual improvement is available.

A striking mathematical theorem is that when the exchange economy is modeled as a noncooperative strategic market game as numbers increase the NCE comes from below the Pareto optimal surface to the surface and can be interpreted as giving rise to an efficient price system.

The Core of a Cooperative Game

It is useful to define the word **imputation** prior to defining the core. An imputation $\alpha = (\alpha_1, \alpha_2, ..., \alpha_n)$ is a vector of n numbers where

$$\sum_{j=1}^{n} \alpha_j = v(n)$$

in words it is a division of all of the wealth that the society as a whole can obtain. We can explain the core and show its importance by means of a three person example.

Consider 3 individuals named 1, 2 and 3. The characteristic function for a 3 person cooperative game has 8 values, one for each of the 8 coalitions that can be formed. We can forget about the coalition of no one that gets nothing, although for full formality it should be defined. For the remaining coalitions we have to assign each one a value. For purposes of illustration the following values are attached:

$$v(1) = v(2) = v(3) = 0$$
$$v(1,2) = v(1,3) = v(2,3) = 5$$
$$v(1,2,3) = 10$$

The core is defined as the set of imputations that cannot be dominated by any subcoalitions claiming that they could improve their gains by independent action. For example, consider the imputation (4,3,3) this imputation (and many others) will be in the core. No pair can effectively offer its members more.

Suppose we consider a different game where

$$v(1) = v(2) = v(3) = 0$$
$$v(1,2) = v(1,3) = v(2,3) = 8$$
$$v(1,2,3) = 10$$

This game has no core. No matter what imputation is suggested for example, (4,3,3) there is some coalition that can guarantee its members more.

The third example shows the possibility of a single point core. Suppose

$$v(1) = v(2) = v(3) = 0$$
$$v(1,2) = v(1,3) = v(2,3) = 6.6\overline{6}$$
$$v(1,2,3) = 10$$

The only imputation that is in the core is $(3.3\overline{3}, 3.3\overline{3}, 3.3\overline{3})$. It turns out that there are many situations involving socially valuable externalities that do not have a price system but do have a core and these cover most of the examples considered by Coase.

The striking mathematical theorem is that when the exchange economy is modeled as a cooperative market game the core always exists and as numbers increase the core shrinks to a point that can be interpreted as a price system.

The Value of a Cooperative Market Game

This solution provides a weighted average over way individual can add strength to any coalition when they join it. We do not develop the formal mathematics here, but note the striking mathematical theorem that when the exchange economy is modeled as a cooperative market game as numbers increase the value converges to the same point as the core and that can be interpreted as an efficient price system.

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[1]In an early paper (Shubik, 1970b) I suggested eight processes. After some years of reflection I have raised the number to fifteen.
[2]One has to always be on guard against popular myth and distorting inaccuracies; but precision depends on purpose. The aim is to present estimates to sensitize the reader to crude orders of magnitude thus it is reasonable to utilize articles from a source such as Wikipedia, sampling some of the references there and noting the reputations of the authors quoted until a high enough degree of confidence is attained.
[3]There is a key game theory result on pairs of individuals and a solution called the core that is explained in the second appendix.
[4]An interesting survey of auctions has been given by (Cassady, 1967).
[5]It is the limit, as many individuals trade, of the cooperative game theory solution called the core that stresses the power of coalitions.
[6]The technical details of a noncooperative equilibrium convergence are given elsewhere [ShuSm 2015].
[7]The high-tech answer is that these include not merely the existence proofs but also convergence proofs of the noncooperative equilibria of strategic market game models of competition with many agents.
[8]In the United States, one could buy one’s way out of going to the civil war (Bernstein, 1991). In China for many years there was a one-child policy and during the Third Reich it was recommended by Heinrich Himmler that members of the SS marry appropriate mates and have at least four children (Stangneth, 2014).
[9]References and more instances are given in (Vicusi, 1993). See also Shubik (1999, p. 391).
[10]The literature in psychology supports the proposition that “framing” matters. Individuals may react differently if told that the chances of being killed are 1 in 10 as contrasted with being told that the chances of surviving are 9 out of 10.
[11]The antiseptic word “payoff” stands for how individuals or firms evaluate any outcome. The concept of preferences can quickly become highly subtle and complex. The study of preferences can fast become the happy hunting ground of the philosophers and legal theorists and provide a sub-industry for some mathematical economists dealing in the implications of formal preference structures..

[12]Some more formal features of game theory are noted in Appendix B.

[13] As with several other Viennese expatriates coming to the United States there was a certain amount of Weiner schmaltz displayed. They were grateful to be here, but they still needed to signal old world charm.

[14]Kriegsspiel is an operational war game, first invented and utilized for training by the Prussian army.

[1515] No feedback from other parts of the economy.

[16]In all of the solutions, the concept of the legitimacy of the original ownership claims is implicitly assumed; see Shubik (2008).

[17]It was also a generalization of an example by Jevons on problem with exchange without money.

[18]The full mathematical models and proofs that they provide process models of a competitive economy are given in Shubik–Smith (2015) and the many articles referred to there.

[19]If the trade were in equilibrium we would expect some form of no arbitrage condition among the 10 prices formed but we are not considering equilibrium yet. We are just showing that we can build a symmetric playable game where the strategic possibilities for all are alike.One could argue that 20 prices are determined, 10 where in every market (i,j) prices are specified in terms of the exchange rate for i, and another 10 where they are specified in terms of j.

[20]There is a large literature that describes the markets in terms of a few individuals and then increases the numbers in a manner that shows the gradual lessening of any individual's influence on the market price. There is another literature using the mathematical topic of **measure theory** to show behavior at the limit when all individual influence over price is lost.

[21]A detailed dynamic mathematical example is given in Shubik–Smith (2015), of an economy utilizing a gold money with and without the introduction of a bank.

[22]The story of gold and monetary gold is a fascinating topic by itself and a brief coverage and listing of good references are given elsewhere; see Shubik (1999, p. 272).

[23] Consider three candidates we call Andy, Bill and Claire and three voters. The Table shows their preferences

	CANDIDATE RATED FIRST	CANDIDATE RATED SECOND	CANDIDATE RATED THIRD
VOTER 1	Andy	Bill	Claire
VOTER 2	Bill	Claire	Andy
VOTER 3	Claire	Andy	Bill

If Claire is proposed as the Winner only Voter 3 prefers her overt the two others. The same holds if Bill or Andy were chosen. Any winner will not be preferred by two thirds of the voters.

[24]A technical mathematical problem is to show that the limiting process involved in considering a sequence of progressively lengthier but finite economies approaches the same solution as that for the infinite horizon economy.

[25]Probably it attenuates at a rate of at least $(1/2)^t$ where t is the number of the generations.

[26]Why use a thousand employees, why not 427? Pre-measurement first calls for a taxonomy and a number such as 1,000 is a way of saying big and more or less anonymous.

[27]In FY 2008, INTERPOL had a staff of 588, representing 84 countries. In addition to 398 contract employees, INTERPOL also had 190 seconded.

[28]Disruption, such as closing down a communication system causes network damage but no direct heavy casualties. Indirect loss of life may be high and grows with the length of disruption.

[29]The mathematical model for this type of dynamics involves the treatment of inequalities; and this, in general, is far harder and messier than solving equations.

[30] Irving Fisher (1867-1947) has been long regarded as the greatest United States economist. He was the son of a Congregational minister. He was a practical inventor with several patents among which was an index visible filing system sold to Kardex Rand. His patents and inestments made him well to do. However his predictions (and beliefs in them in 1929) that the stock-market prices reflected an era of prosperity wiped out his assets. In spite of his presidencies of the American Economic Association and the Econometric Society and brilliance as a theorist, the gap between theory and practice was illustrated in his personal affairs.

[31]The price of money, as contrasted with the rental price of money is the quantity of the asset money offered for a unit of the asset money and by convention we may assume this to be one. A social psychologist can mount evidence that many people would pass by an individual trying to sell five dollar bills for a dollar, but such evidence deals more with inability to validate forgery and suspicion of bizarre behavior than a denial of the proposition.

[32]See Shubik–Smith (2015, Ch. 6, 8) and Gorton (2012) for reviews of some of the considerable literature.

[33]Even this single extra piece of paper can be made somewhat complicated by rules that determine whether or not it is transferable to a third party, and how long it can last.

[34]Jay Forrester of MIT has been a strong advocate of this approach with a sequence of books on industrial, urban and world dynamics. This work provided much of the intellectual basis for a group called The Club of Rome who in 1972 published a book entitled *Limits to Growth*.

[35]An example for Civil War buffs, might be the near random event on who occupied Little Round Top first. This may have been critical to the unfolding Battle of Gettysburg.

[36]Some direct concern of the stockholders or their fiduciaries might be restored by having a graduated short term capital gains tax that called for no special allowance for a holding for less than a year going down to very little for holdings for say, five or six years or more.

[37]Shubik and Sudderth (2011) were able to investigate government sponsored innovation utilizing methods of parallel dynamic programming.

[38]In a book as brief and nontechnical as this it is hard to do justice to the complexity oriented approaches to organization that are playing an increasingly important role in economic analysis. The edited volume by Blume and Durlauf (2006) provides an example of this type of approach.

[39] It is discussed somewhat technically in Appendix B

[40] This is discussed in detail in Shubik and Smith (2015, see Ch. 1, 3, and 11)

[41]Technically referred to as coarse or fine graining in physics.

[42] This is essentially the problem with terrorist control. There is no way to get down to zero terrorism. One must select what level is acceptable and affordable.

[43]As an undergraduate I was politically active and joined the then named, CCF left wing party in Canada and was associated with The Canadian Forum, a Canadian publication in the spirit of the Fabian Society. While a senior at the University of Toronto I studied the CCF proposal for the electrification of north Ontario which was sparsely populated. I concluded that their platform which involved building many miles of transmission cable and the placement of power stations had little to do with the needs and had overwhelming costs. The rhetoric stressed benefits and downplayed costs. Within the year I decided to give up politics and to take a graduate degree in political economy at the University of Toronto.

In 1948 while studying for my MA in Toronto, I started to read the *Theory of Games and Economic Behavior*, a copy of which was on the new book shelf in the library. I was convinced that this contained the key to opening up economics and other social sciences to quantitative and mathematical methods. I decided to go to Princeton to work on a PhD. in game theory.

My stay at the Center for Advanced Study in the Behavioral Sciences together with my years at General Electric and IBM and my consulting at the RAND Corporation forced me to see the enormous gaps between economic reality and the rhetoric of the political parties of both the left and right.

[44]Snopes fact checking states that these rumors are false, but a bill to set $\pi = 3.14$ was considered in Indiana, but died in the Senate.

[45] Estimate from UN website, 2015.

[46]Various estimates for a meteor of a mile in diameter or larger indicate that its impact could wipe out all life. Thus no international organization is required to aid in recovery.

[47] The United States' civil war was possibly the first fully modern war.

[48]A crude estimate uses (65 – 20) = 45 for the years worked. Eighty years for life span. Two hundred days a year as a crude approximation for days worked, 365 for days in the year. 8 hours for sleep. These give (45 x 8 x 200)/(80 x 16 x 365) = .15411.

[49]The possibility of two party bargaining with asymmetric information was first discussed by Ackerlof (1970) in his paper on “The Market for Lemons.”

The inspection problem in applying for funding was proposed in a RAND publication (Shubik, 1970b) suggested by budgeting of supply centers in the US naval supply system.

[50]For example, left out are Sun flares, volcanic activity, the usual Science Fiction threat of extra terrestrial invaders, and many others.

[51]This includes the possible influences of chemical and biological warfare.

[52]The recent work by Martin and Pindyck (2015) offer an economic analysis approach, I believe however that due to the variety in time lags the problem of how this is modified by political concerns requires consideration.

[53]As well as rebuilding an atmosphere or meteor-changed earth that may have had much, if not all, of its population wiped out.

[54]The formal axioms were first given in von Neumann and Morgenstern (1947).