CHAPTER 14

Market Design and Market Failure

CARLOS CAÑÓN, GUIDO FRIEBEL, AND PAUL SEABRIGHT

Introduction

Markets are institutions that enable the exchange of valued goods and services—what are sometimes called economic transactions—between consenting partners.[1] They are not the only institutions to play this role: transactions can take place within families, within firms, in social networks, and in many other kinds of social context. What is distinctive about markets is that they are anonymous. By this we mean not that the participants in market exchange are necessarily unaware of each other's identity, but rather that they are able to trade with each other purely through participating in the market and not through any prior privileged relationship. The market makes it possible for market participants to carry out exchanges they would otherwise not be able to do. The market does its work when parties who might benefit from transacting need a structured setting in which to make that transaction possible.

It is hard to overstate how important have been the development of markets in the history of humanity. The division of labor is a very ancient phenomenon in the animal kingdom, at least as old as the origin of sexual reproduction, though it takes a very rudimentary form in most species. Conscious exchange of favors or resources between individuals is a phenomenon more common in birds and mammals, especially in the higher primates,[2] though it tends to take the form either of assistance to close kin, or the exchange of food for immediate favors, typically either status recognition or sexual access to females. Human beings differ from most other mammals, including our closest relatives, the great apes, in having an elaborate sexual division of labor with substantial paternal care. In addition, it seems likely that within the hunter-gatherer bands that constituted the setting for almost all our physical and psychological evolution, there was some intragender specialization of work by skill, and there is also suggestive evidence of sporadic exchange of goods.

However, none of these activities required markets in our sense of the term. Most economic exchange prior to the adoption of agriculture was mediated by kinship networks, or took place between individuals or groups who, though

not closely related, had built up ties of familiarity over a long period of time. Markets, by contrast, were necessary once human beings perceived the need to exchange with strangers—a phenomenon essentially unknown in the rest of the animal kingdom, and very rare indeed even between human beings prior to the Neolithic era. For markets to become established has required overcoming some important natural obstacles—but without markets to enable exchange between strangers, none of the development of human civilization would have been possible.

The market in itself is a remarkable innovation created to make transactions between strangers possible, but the process of institutional innovation does not stop at the creation of the marketplace as such. There has been a continuous historical process of innovation responding to the various problems that market exchange has revealed. In this chapter we provide a very summary overview of the now vast literature on how markets emerge, how markets can work, how they can fail to work,[3] and finally, on the conditions under which conscious market design, by individuals, groups, or whole societies, has sought to remedy some of the defects of markets.

Economists have traditionally thought differently from other social scientists about markets. Various scholars in sociology have studied how market and social relationships interact, re-enforce, or contradict each other. Two bodies of literature have emerged, one on the social dimension of the market, looking at information transmission, social norms, and identity, the other on "relational contracting," which investigates how bilateral relations are embedded in the forces and temptations of the market.[4] These new developments, while fascinating, are of limited relevance to the issues of market design, so our review will adopt a somewhat more traditional economic approach. We look at markets with a large number of (potential) participants who cannot influence market outcomes and do not have the means to build up social networks or bilateral relationships that can support or replace the market as the main coordination and exchange mechanism.

The defects of the market can take many forms, as we describe in detail below. Transactions may provoke accusations of unfairness either on the part of some of their participants or on the part of those who do not or cannot participate. There can likewise be many types of response to these defects. Political authorities may decide to regulate transactions by legislative or administrative intervention. Alternatively, individuals or groups of individuals may decide to create private organizations, groups, or networks to deal with the problem. Finally, governments or groups of individuals may seek to modify the design of the market in question, or design a new market where none has existed.

The focus of this paper is market design, a relatively young field of economics that has proven one of the most fruitful and relevant applications of economic theory for the real world, and whose "inventors" Alvin E. Roth and Lloyd S. Shapley have been awarded the 2012 Prize in Economics in memory of Alfred Nobel of the Swedish Riksbank. It is nonetheless noteworthy that the three solutions—external or government regulation, organization through formal institutions such as firms or informal ones such as networks, and market design—have coexisted for a long time. None of them are intrinsically superior

to the other solutions in general, though some solutions seem to be more appropriate for some types of problems. Among ways of regulating prices, external political regulation, though by no means free of problems, is a great improvement on letting firms self-regulate in a cartel or through unrestricted mergers. For limiting entry of producers to those suitably qualified, both external regulations and self-regulation through guilds can work, but market design is a less appropriate tool. By contrast, although the environment can be protected by government regulation that imposes emission standards, an even better instrument may be to design a market on which pollution rights can be traded. Finally, a firm may seek to overcome the uncertainties of the market by integrating with its suppliers. But an effective alternative may be to create a network with them, or to use business-to-business Internet platforms to deal more efficiently with them.

In a nutshell, different problems call for different solutions. We here focus on the improvements to existing markets and the creation of new markets in response to the perception of market failure. We provide a short description of how markets have come to be established and have evolved over time, and then look at the characteristics of market outcomes, both their achievements and their failings. This provides the structure to examine various initiatives undertaken to improve on market outcomes where markets fail to achieve good solutions for society or where they do not exist at all.

The Establishment and Evolution of Markets

Exchange occurs fairly naturally between people who are closely related by blood and between those who interact repeatedly and know each other well, but in groups larger than the typical hunter-gatherer band, more formal settings may be needed to make trade possible. Swedberg (2005) discusses the historical evolution of markets without distinguishing between those that *naturally* arose, and those that were consciously designed (see Figure 14.1 overleaf). Although it is tempting to classify all states of market evolution between these two categories, we will not do so, because there is no consensus in the literature.

The author argues that in early stages of human societies markets were *external* only, in the sense that commerce took place between different groups. Groups were, however, small enough that within each group there could be a division of labor without need of markets. The author also suggests that commerce was accomplished mainly through barter, as there was no "external" money. The absence of money in early stages of human evolution reflects the fact that commerce requires a network of political and legal regulations. Such conditions are complex and naturally arise first inside each ethnic group.

Several historical examples can be identified. An early documented case, according to Bowles (2004), is the commerce between the Libyans and the Carthaginians in the fifth century B.C., as described by Herodotus. Trading practices were very particular: the Carthaginians approached first, dropped their merchandise, and withdrew. Then the Libyans approached, inspected the merchandise and left gold, withdrawing without taking the goods. Then the Carthaginians approached again and adjusted the amount of merchandise toward what they considered equivalent in value to the gold provided by the

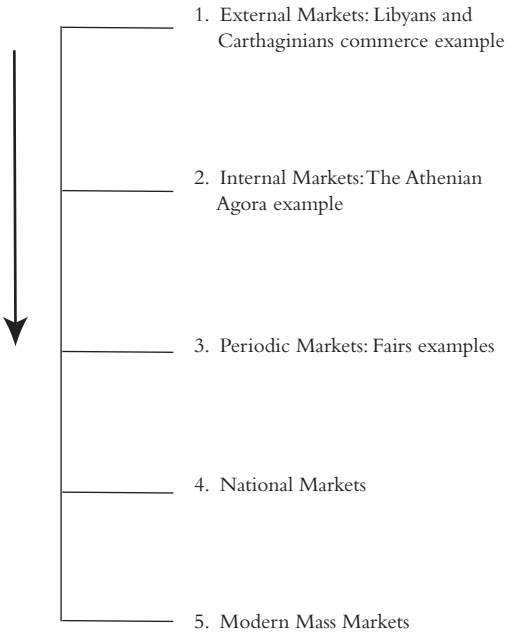

FIGURE 14.1. Historical evolution of markets.

Libyans. This process continued until both parties reached an agreement. The second stage in market evolution is what Swedberg calls *internal* markets. In this stage, members from the group have commerce among themselves using "internal" money,[5] as well as with other groups. The Athenian *Agora* represents an appropriate example because their societies had achieved great sophistication, and because these city-states were not subordinate to any other city.[6] Athenian institutions aimed to provide conditions under which internal commerce could take place. For example, they created the post of *agoranomoi*, whose mission was to ensure the quality of goods in the market (a concern for the consumer echoed in medieval times in the long debates about the "just price"). They also guaranteed the quality of all coins used at the *Agora*.

Other examples of internal markets can be found in the literature. Rosenfeld and Menirav (2001) study prices in the third to fourth centuries A.D. in Roman Palestine. They show that prices were not seasonally fixed, but were continually changed based on market forces; however, the Roman authorities constantly supervised prices so as to avoid great fluctuations. Another example is provided by Warburton (2000), who studies the role of the Egyptian state at the end of the third millennium B.C., whose economic success, the author argues, was the result not of technological innovations or market-based policies but rather substantial state spending financed by taxes.

Usually, long-distance trading rents are higher than local trading rents, so that the next step in the evolution of markets is the periodic meeting of merchants from very distant places in a secure location. This type of market is a combination between "external" and "internal" markets. Merchants from different communities may gather to take advantage of significant trading opportunities, but the new market must provide conditions similar to those in

"internal" markets, so as to reduce the various kinds of costs and risks associated with the transactions.

Fairs that took place in Europe between the eleventh and fourteenth centuries represent a good example of these periodic markets.[7] According to Swedberg, fairs had a major impact because ordinary people could participate, and also because products were brought from all over Europe. Such an event was not easy to organize. Fairs were usually hosted by a local baron, who provided the appropriate physical security. Fairs began to decline when growing trade volumes required permanent rather than periodic markets.

Many scholars have studied the nature of fairs and their impact. Epstein (1994) argues that fairs during the fourteenth and fifteenth centuries represent institutional innovations that helped reduce transaction costs and whose impact was mainly regional. In particular, fairs fostered regional specialization that shaped long-term growth in Europe,[8] especially after the Black Death. Fairs became also popular in other parts of the world.[9]

There are strong ties between fairs and local or regional associations. Indeed, any association was entitled periodically to organize a fair at which traders could show their products, exchange experiences, and learn about their competitors. Eventually, regional associations' interests could be strong enough to create broader associations, of which one well-known example is the Hanseatic League,[10] an association of German towns from Holland to Finland that controlled the Baltic and North Sea from the thirteenth through the sixteenth centuries.[11] They created their own regulation, and according to Daenell (1909), were responsible for promoting and securing ships and for improving conditions of trade.[12]

The step toward national markets, the next phase in market evolution, is not an easy one. In particular, national markets must unify many local markets that need not previously have used the same rules. Kings, nation-states, and other supraregional institutions played an important role in overcoming inconsistencies between the rules of small local markets.[13] For example, Louis XI of France helped to consolidate a national market by unifying weights and measures. Unification of local markets can also be achieved without the public sector. For the case of nineteenth-century Japan, Miwa and Ramseyer (2006) argue that Japan's impressive economic growth was anticipated by a revolution in the financial industry, but one that was the result of the private sector rather than the Japanese state.

Modern mass markets are the most recent stage of market evolution. Markets need no longer be confined to a particular geographical area but can spread across national and regional boundaries in ways limited only by transport and communication costs, which have fallen massively over time and for some goods and services are now close to zero anywhere in the world. While examples from finance and information technology spring readily to mind, it is worth being reminded that market integration has proceeded rapidly for many much less glamorous products. For example, consider the case of the international rice market, a good that was not as popular in the West as in the East. Coclains (1993) documents the rise of this particular market as an example of how new mass markets boosted product consumption and production in areas not used to consuming or producing it.

We are currently in the early phase of a new surge in market design, some of whose manifestations we describe in detail below. In such an early stage the problems of market design can sometimes loom larger than the successes. The main challenge for future market engineers, according to Roth (2002), is to understand market details so that policies end up achieving their objectives. For example, Vermeulen, Buch, and Greenwood (2007) study the failed state-driven attempt to introduce granular, a recycled (and hence environment-friendly) substitute for primary materials like sand and gravel into the construction industry in the Netherlands. In particular, if policy-makers do not fully understand the incentives that incumbent organizations and market players face, new policies will not easily achieve their goals.[14]

New markets have brought remarkable consequences. One of the most important is the dramatic changes in people's eating, working, and clothing habits, and the spectacular increase in health, prosperity, and longevity that this has made possible across the world, with the disturbing exceptions of persistent mass poverty in some parts of the Third World. Another consequence is that people in many countries depend on the performance of other economies, and their prosperity can be undermined by events occurring on the other side of the world. And finally, a new type of firm, the multinational corporation, has since the twentieth century played a decisive role in the development of the world economy.

How Can the Market Possibly Work?

On the face of it the development of markets that link the globe and have revolutionized living standards represents a triumph of cooperation by a species of large-brained ape that, as Seabright (2010) emphasizes, is so violent and devious that it never seemed cut out for global cooperation at all. However, the profound impact of Adam Smith's *The Wealth of Nations* (1776) lay in its demonstration that such large-scale cooperation appeared to require rather little of its participants, and in particular that it did not require them to be benevolent, but merely intelligently self-interested.

Later generations of economists, notably Walras (1874) and Arrow and Debreu (1954), developed and refined these arguments, proving in particular the two fundamental theorems of welfare economics. The first theorem states that an economy consisting purely of self-interested individuals interacting in perfectly competitive markets will have an equilibrium that is Pareto-efficient, in the sense that all opportunities for mutually beneficial interaction have been exhausted and that any further potential improvements in the welfare of one individual would have to be at the expense of some other individual. Pareto-efficient outcomes may not necessarily be desirable (in particular they may be highly inequitable), but the second theorem states that any Pareto-efficient outcome, including those that have desirable equity properties, can be attained as an equilibrium of perfectly competitive markets with purely self-interested participants, starting from some initial allocation of endowments.

The conditions embodied in the hypothesis of perfectly competitive markets are weak in the sense that they do not require any degree of altruism or cooperative spirit. They are, however, highly demanding in terms of the cognitive capacities of

the participants and the sophistication of their institutional arrangements. Most real people—even sophisticated financial players—seem to be limited in their cognitive capabilities, and most real markets do not even begin to approximate these highly demanding conditions, which leaves open the question of how satisfactory we can expect the outcomes they deliver to be.

There has been important research both documenting the limited cognitive capabilities of agents,[15] and exploring ways in which markets might be regulated, designed, or otherwise modified to take these cognitive limitations into account. For instance, evidence that consumers are highly sensitive to the framing of choice possibilities (such as choices to participate in programs for health insurance, retirement savings, or organ donation) implies a possible role for regulation of the way in which such choices may legitimately be presented to them.[16] Surveying this literature is beyond the scope of this chapter, but readers should be aware that this is an important and growing field of research.

In addition, the theorems do not explain how individuals might reach such an equilibrium beginning from a state in which no trade has yet taken place, and therefore do not cast much light on the processes by which market evolution historically occurred. The next question is therefore to identify and explain how market participants reach equilibria such as those described in the two welfare theorems.

Three recent strands of literature have begun seriously to examine this question.[17] The first, which maintains the assumption that individuals are self-interested and lack intrinsically cooperative characteristics, considers the dynamics of convergence to equilibrium in conditions resembling markets. In the so-called general equilibrium model of Walras (1874), an artificial central authority was invoked. The role of this "auctioneer" was to signal prices to market participants and to adjust these prices (through a process known as "tâtonnement") so that supply and demand would match in all markets. It is now known, however, that stability of equilibrium in both continuous and discrete models is ensured only under unrealistically stringent conditions on this tâtonnement process.[18]

How could markets evolve in time so that prices and quantities in a decentralized model—that is, one without an auctioneer—converge to market-clearing allocations?[19] What kind of conditions do preferences, prices, and markets have to satisfy for this to occur? Although no analytical solutions are available at the moment, new empirical studies based on computer simulations have obtained interesting results.

Following Schinkel, Tuinstra, and Vermeulen (2002), it is possible to trace to Arrow (1959) the first attempt to explain how prices are formed in a model of general equilibrium without an auctioneer; in his version, followed by many others, prices are also a choice variable of the firms. Fisher (1983) proposes a different story: he conceived several dealers, each specialized in one good, whose role is to coordinate and set prices; dealers are not auctioneers and have market power.[20] Hahn (1989) modeled a process of monopolistically competitive price-setters.

More recent attempts include the work of Schinkel, Tuinstra, and Vermeulen (2002). The novelty of their work is that firms are uncertain about the demand they face. Each firm makes a conjecture about demand based on previous

information on prices and sales. Moreover, firms will periodically update the parameters of their demand based on new information using Bayesian criteria. Within this framework the price process will be globally stable.

Gintis (2007) explores the general equilibrium dynamic of a fully decentralized Walrasian economy using computer simulations.[21] He succeeds in constructing a decentralized Walrasian economy that, under wide conditions, exhibits a unique and globally stable equilibrium that is "very close to" the Pareto-efficient outcome. The key requirement for obtaining such a result is that prices cannot be public;[22] agents have *private prices*. Agents will have reservation prices that they will use to decide with whom they will trade, prices will be updated by trial and error, and by imitating the behavior of high-performance agents. Using a simplified version of the Gintis model (2007), Gintis (2006) shows that a "price system" can be obtained in the medium run when agents have such *private prices*,[23] and it is also shown that in the long run the "price system" converges to a stationary distribution that may be understood as a system of Walrasian competitive prices.

The main lesson from Gintis (2006, 2007) for this chapter is that imitation is the driving force behind market dynamics. In particular, Gintis assumes that in each period a fraction of low-performance agents will mimic the behavior of high-performance agents; loosely speaking, weak agents are successively replaced by stronger agents, which makes the role of markets very *Darwinian* in the sense that only the "strongest" agents survive. It follows from this that successful markets, those whose outcomes are considered *desirable*, must evolve in time. And market evolution must have certain characteristics—specifically that it should reward *successful* agents.[24]

The second strand of literature is devoted to understanding the dynamics of realistic economic systems using only mathematical and computational tools.[25] These contributions explore in particular the extent to which complex market systems may be unstable under plausible descriptions of the way in which their component processes evolve over time. Asada et al. (2006) propose a generalization of a standard Aggregate Supply-Aggregate Demand dynamic growth model,[26] capable of generating business cycles.[27] Their most important result is to show that even when there is no stable steady state of the model, it makes an important difference whether the cycles that can occur around the steady state remain bounded or whether they can become explosive, resulting in large-scale "crises."[28]

Finally, a small strand of literature has explored whether market evolution may be more likely if participants have more cooperative characteristics than those that were apparent to Adam Smith.[29] This is particularly important given that Walrasian models of markets (including those that discuss disequilibrium dynamics) typically ignore the question of how participants can be sure that the agreements they reach will be enforced—the key issue being whether and how they will reach agreements that, if enforced, would be efficient. In reality, of course, the enforceability of agreements has often been something about which market participants have had very justifiable doubts.

We now turn to the question of what happens when markets are established, but under conditions that fall short of the Walrasian ideal type. What kinds of outcome can be expected?

Why Markets May Fail

Above we have discussed how individuals may master the cognitive challenge posed by market interactions. For the fundamental theorems of welfare economics to hold there are, however, additional and quite stringent conditions:

- Contracts for trade in markets must be costlessly signed and costlessly enforceable;
- Markets must be perfectly competitive in the sense that there must be a large number of buyers and sellers so that no individual participant has the ability to influence the market price—in other words, there must be no "market power";
- There must be no asymmetric information—information known to one party but not to others—though there can be shared uncertainty about what will happen in the future (uncertainty over which individuals may wish to trade in insurance markets);
- Markets must be complete, in the sense that they must exist not only for all actual commodities but also for all named and contingent commodities.

The notions of named and contingent commodities deserve some clarification. *Named commodities* represent the effects of transactions on third parties. For many goods these are negligible, but they are important for externalities such as pollution, where one party's consumption or production causes a loss of welfare for a third party, when there is typically no market in which the polluter and pollutee can reach a mutually satisfactory accommodation. *Contingent commodities* are those that occur only in some (uncertain) circumstances, and without markets for contingent commodities there will be inefficiently low levels of insurance.

It is evident that no real markets anywhere have ever precisely satisfied these conditions, but they are nevertheless analytically useful, for two reasons. One is that markets that are in some sense "close" to satisfying the conditions may also produce outcomes "close" to efficient ones. The second is that the kinds of pathologies that real markets display can be understood much better if one knows which of the conditions most significantly fail to hold. Thus markets where there is important monopoly power by one party behave quite differently from markets where the main problem is an asymmetry of information between buyers and sellers, and differently again from those where externalities are a major concern. In a nutshell:

- When there are transaction costs in writing and enforcing contracts, and when there are costs of haggling in the marketplace, market interactions may be less promising than moving the interactions within the boundaries of organizations, as Coase (1937) and Williamson (1970) have shown.
- Where one or more firms have market power, they will often seek to raise prices so as to make some of their clients pay more, thereby excluding from the market those who would have been willing to pay the competitive price but not the higher price. These excluded customers represent the "deadweight loss" of monopoly power.[30] Solutions to market power are the domain of competition policy,[31] where it is possible to keep markets

reasonably competitive,[32] and of direct regulation of prices and other behavior where it is not possible to do so.[33]

- Asymmetric information typically leads to two kinds of problem. In the first, known as *adverse selection*, low-quality goods driving out high-quality ones, because suppliers of high-quality ones cannot credibly distinguish themselves from the rest. These problems pervade all kinds of markets, from used cars (Akerlof 1970) to insurance (Rothschild and Stiglitz 1976). The second kind of problem is known as *moral hazard,*[34] and results when the unobservability of behavior prevents market participants from committing themselves to behave in ways that would be to the advantage of all—for instance, insured parties may be unable credibly to promise to take reasonable care to protect against risk.
- Externalities typically result in inefficiently large amounts of the activity creating negative externalities and inefficiently little of the activity creating positive externalities. Historically this has often been regulated by direct controls on activities (so-called command-and-control methods); in recent years more often by taxes and subsidies, and much more recently (as we discuss below) sometimes by direct creation of markets in which "pollution" rights can be directly traded by any parties that have an interest in them. This last approach is the most consistent with the analysis of externalities as involving a problem of "missing markets."

There is a truly vast literature on "market failure" that we cannot realistically review in this chapter. What we shall do instead is to consider examples in which markets have failed, not so much because of contracting problems or market power but because of information asymmetries and externalities. We will focus on conscious efforts at comprehensive market design to deal with information asymmetry and externalities. Economic analysis has demonstrated that in the presence of externalities and asymmetric information it is not realistic to expect perfect solutions to incentive problems. Bengt Holmstrom's celebrated Impossibility Theorem has shown that no incentive system for a production task where one individual's productivity depends on the efforts of others (which implies the presence of externalities), and in which individuals' efforts cannot be observed, can satisfy simultaneously the requirements of Pareto-efficiency, individual rationality (as expressed in the notion of Nash equilibrium), and budget balance—namely, that all revenues created by the production process are distributed to the agents. Market design can improve upon laissez-faire, but Pareto-efficiency may not be a realistic result to expect from the market design process. However, the precise implications of Holmstrom's Theorem for market design remain unclear, and will doubtless be the subject of much discussion in the future.

We begin with some of the best known examples of market design—the markets for rights to inflict externalities such as pollution. We go on to consider market-based solutions to asymmetric information problems, and conclude with some of the most intricate market-design initiatives of all—those involving matching markets such as the markets for professional placements, where both externalities and asymmetric problems matter simultaneously, and where timing problems magnify the extent of mistakes.

In evaluating these initiatives it is important to use a realistic standard, which as we explained above does not usually mean the criterion of Pareto-efficiency. For instance, we know that when borrowers know more than lenders about the quality of their projects, credit markets will always lead to some inefficient outcomes; there will always be some loans that lenders would not have made had they known as much as the borrowers did. A much more useful question is whether credit markets are working as effectively as they reasonably could, given that borrowers will always know more than lenders (this is sometimes known as the standard of the "second best"). The answer is often that they do not, and market design will be judged effective if they lead to significant improvements rather than being found wanting for failing to re-establish "first-best"—that is, fully efficient—outcomes.

Examples of Market Design

EXTERNALITIES

The best known example of artificially created markets is the U.S. market for pollution rights created by the Title IV Clean Air Amendment of 1990; its objective was to reduce pollution emissions drastically, but to do so at acceptable cost by issuing firms with emissions rights that they could subsequently trade. Recent studies show benefits substantially outweighing the costs of having a cleaner environment. The second example is New Zealand's response to the problem of overfishing by the creation of the Individual Transferable Quotas System. Its objective was to define a maximum annual catch, and to define and enforce the rules for trading individual quotas.[35] Several studies show that this artificial market became progressively thicker with time; the perceived benefits led to the adoption of similar schemes by several other countries. The third example is another market for pollution permits—this time the one established by the European Union for carbon dioxide emissions permits, a market that began trading in 2005 and faced a major collapse in the trading price early in the process. This last example serves as a lesson that even well-conceived artificial markets can face significant problems of implementation if important details are overlooked.

Externalities are not a new problem for policy-makers.[36] Long before economists such as A. C. Pigou or E. Lindahl started studying externalities, policy-makers knew that it is only on rare occasions that individual decisions can be treated in complete isolation. Current examples of externalities that preoccupy policy-makers include SO_2 and NO_x emissions,[37] carbon dioxide emission and its effect on global climate change, and the effect of fishing on marine ecosystems.

Even if we can state in general terms that externalities are a problem where there are no markets allowing them to be internalized, following Heller and Starrett (1976) it is often useful to go deeper and examine the reasons why these markets fail to exist. Four main obstacles are (1) difficulties in defining property rights, (2) market power, (3) asymmetric information, and (4) indivisibilities in production or the impossibility of combining certain goods.[38] Consider the example of SO_2 emissions in China. The fact that thermoelectric generation in China produces too much SO_2 is the consequence of the absence

of any clear property rights regime that entitles factories to produce a certain amount of SO_2 and for those that suffer from pollution to bargain for emissions reductions.

Irrespective of the cause, the fact that externalities imply missing markets has led many policy-makers to consider creating *artificial* markets as a method to correct externalities. Three examples will be considered in detail. Two of these are markets for pollution permits; the third is a novel implementation in fisheries.

U.S. Title IV Clean Air Act Amendment of 1990

Prior to the Clean Air Act (CAA) there had been two partially successful attempts to reduce pollutant emissions in the United States. The first was an initiative of the Environmental Protection Agency (EPA) in the 1970s to allow states to take independent measures to control air pollutant emissions using a form of tradable permits. The second was the imposition of stringent standards on leaded gasoline and ozone-depleting chlorofluorocarbons.[39]

The CAA had one main objective and was designed in two phases. The U.S. government stated that the CAA should ensure that SO_2 emissions would, by the year 2000, be 10 million tons below the 1980 level, and half of the 1980 level by 2010. Although the main objective was not fully achieved—SO_2 emissions were in excess of 7 million tons below 1980 levels—emission reductions were substantial, especially in places with higher emissions.[40] In order to achieve the objective the CAA stipulated a maximum level of emissions for each polluting unit, and designed a tradable market for SO_2 permits that began working in 1993.[41]

The first phase of the CAA took from 1990 until 1995. Stavins (1998) documents that in this phase sixty-one utility units, which controlled a total of 110 electric utility plants, were endowed with individual emission limits.[42] The criteria for assigning permits was unavoidably ad hoc, with the endowment of each "polluting unit" depending on its fuel input share in 1987–88. However, the performance of the CAA has been largely satisfactory (see Stavins 1998 Schmalensee et al. 1998). Since 1993 the market for permits has become increasingly sophisticated. More recent studies, such as Chestnut and Mills (2005), argue that even using the most conservative methods to quantify CAA benefits on human health and on the environment, the benefits greatly outweigh the cost, largely because studies in the last two decades have shown that SO_2 and NO_x are more harmful than previously believed.[43]

Several factors explain the success of the CAA. The first and most important is its recognition that firms have different abatement costs, and its provision of means to allocate emission reductions to those able to undertake them at lowest cost. Firms with lower abatement costs will sell some of the permits in their entitlement, and firms with higher abatement costs will buy additional permits. By the same reasoning, high abatement-cost firms will have incentives to reduce costs in the long run, since unless they do so competition will drive them out of the market.

The second reason for the success of the CAA is that permits could be *banked*. That is, firms could choose to emit less than their entitlement in a

given period and emit more later. Bankable permits were a useful tool because firms were easily able to predict their future emissions requirements, though evidently that would be more difficult in some other industries (such as the New Zealand fisheries we examine below).[44]

The third reason for the success of the CAA is that the EPA created a means of reducing market failures caused by asymmetric information between public utilities. Much trade in permits is private between utilities, but the annual auction of permits sponsored by the EPA enables firms to learn about market conditions and the opportunities open to other firms, an important benefit of the open system according to Stavins (1998) and Schmalensee et al. (1998).

NEW ZEALAND'S FISHING MARKET[45]

Another interesting example of a designed market is New Zealand's Individual Transferable Quotas (ITQ) System.[46] New Zealand currently leads the world in fisheries management, both economically and environmentally. Its example was subsequently followed by Australia, Canada, Iceland, and the United States.

Fisheries suffer from the disadvantages of all common-property resources. Without appropriate regulation, fishing firms will not necessarily internalize the cost of overfishing, so that the overall annual catch is likely to exceed a sustainable level. New Zealand, like many other countries, was urged by the mid-1980s to establish and enforce a maximum level of catch (named Total Annual Catch, hereafter TAC). As a result, the 1986 Fisheries Amendment Act was passed.

The fishing market created by that act resembles the emissions market created by the CAA. The New Zealand government determines the amount of fish that may be caught in a particular area. The TAC is not necessarily the economically efficient annual level of catch; but it is designed to be a sustainable maximum level of catch. Next, the government allocates quotas for fishing in a specific area, quotas that may be bought and sold and even leased in fractions.[47]

There are two differences compared with the CAA market. First, as we have indicated, it is more difficult for a firm to predict the future level and composition of the catch, than for a polluting unit to predict the future level of emissions. At an intuitive level, this is because more factors must be taken into account in the fishing industry.[48] Among the consequences of this difficulty of prediction is that firms must bear more residual risk; in addition. quotas are not as liquid as pollution permits. Fishing quotas are generally tradable *only* for the same fish stock, and are not tradable across regions or years. Quotas are still bankable, but trading possibilities are more limited than for pollution permits.

Newell, Sanchirico, and Kerr (2005), using data covering fifteen years of transactions, argue that New Zealand's market is becoming more and more competitive. They claim that market thickness has steadily improved—meaning that more sellers and buyers are coming to the market every year. In addition, market price dispersion has decreased, suggesting that firms' market power has decreased as well.

The main remaining problem, they argue, is asymmetric information

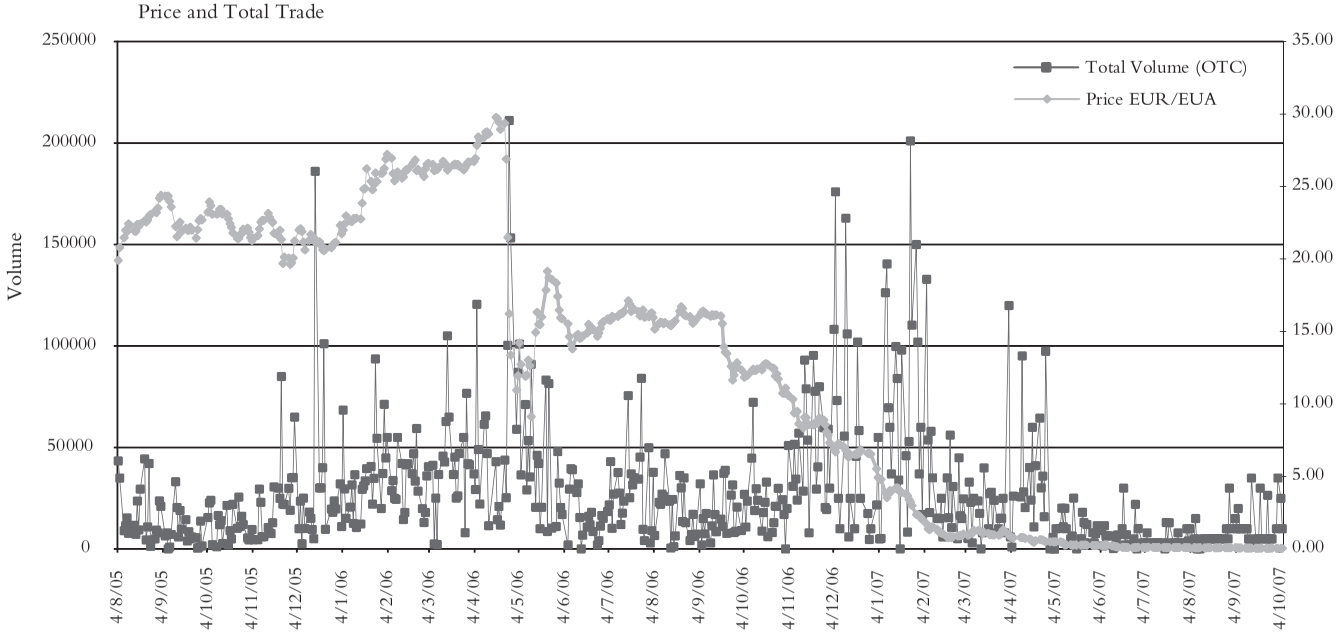

FIGURE 14.2. Price of allowances and volume of trade from August 2005 to October 2007, European Energy Exchange. Source: European Energy Exchange (EEX) EU emissions, various years.

between market participants, and they advocate creating a central trading center to address this.

THE EUROPEAN UNION EMISSIONS TRADING SCHEME

The European Union Emission Trading Scheme (EU ETS), which opened for trading in 2005, shares a number of features with the U.S. emissions markets. First, its objective is to reduce CO_2 emissions by controlling the major emitters. Secondly, each year the authorities issue a fixed number of emission permits to emitting firms. Thirdly, emitters may trade their allowances based on their current and future needs.

There are also many differences between the European Union and the United States; we shall address only one.[49] The EU ETS is the world's largest multinational gas emission trading scheme. Political economy issues, such as industry and country lobbying, are much more complex than in the U.S. scheme. Even in the early life of the scheme these have had a major impact on its operation.

The EU ETS was conceived in three phases. The first (2005–7) covered twelve thousand emitting firms from several industries,[50] which accounted for 40 percent of the EU's CO_2 emissions. The second phase (2008–12) planned to include greenhouse gases other than CO_2, including the aviation industry, and to include non-EU members.[51] The last phase (2013–20) extends the controls over new sectors (petrochemicals, ammonia, and aluminum among others) and over new gases, specially Nitrous Oxide.

Figure 14.2 shows the price of allowances and the volume of trade from August 2005 to October 2007; in particular, the price reached a peak of 30 euros per ton of CO_2 in April of 2006. But in May of 2006 the market crashed when it became clear that most governments had issued so many allowances that very few firms would need to reduce their CO_2 emissions, so that there would be few buyers in the market and a potentially large number of sellers. By October 2007 the price had fallen to 0.05 euros per ton of CO_2, and trade volume had reached a historical minimum. It was widely hoped that Phase II provided stricter levels of initial allowances that ensured significant aggregate reductions of CO_2 emissions for the EU zone.

The experience illustrates an important lesson for market design. By devolving to member countries the right to choose initial allocations of permits, the EU scheme replicated at the market implementation stage the same kinds of externalities that the scheme was designed to correct. Carbon dioxide emissions create global, not local, externalities, so countries have an incentive to free-ride on the reduction efforts of others. It is not enough to create a market; the details of that market have to respond to the problem the market is intended to solve.

MARKET DESIGN IN THE PRESENCE OF EXTERNALITIES: GENERAL ARGUMENTS

What can we learn that is of general value from these and other experiments? According to Ledyard and Szakaly-Moore (1994), the performance of any organization that allows trading of property rights such as emissions permits

depends on two factors: market design and political viability. Moreover, the two desiderata may not be simultaneously attainable. For example, although an optimally designed auction of permits will be efficient, it may be politically infeasible if it does not consider wealth distribution implications. On the other hand, if the government distributes all permits based on a particular arbitrary criterion (called *grandfathering* from hereon), this method will be politically feasible but may be inefficient—in particular, when reallocation of the grandfather rights is forbidden or made difficult by other features of the institutional design (such as a "use-it-or-lose-it" rule, which encourages using of rights even when it would be efficient to forgo them).

Optimally designed pollution-rights trading organizations will therefore have two components, one political and other market-based.[52] While the former typically safeguard society's status quo from significant wealth redistributions, the latter will correct the externality, but there may be a tension between the two, as the EU's ETS illustrates. There is no a priori golden rule for constructing such two-part optimal organizations;[53] following Roth (2002), as the success of new artificial markets relies on paying attention to details, optimal organizations will be case specific.[54]

Despite the heterogeneity of well-designed organizations, they tend to have certain basic objectives in common. In the case of the CAA, Stavins (1998) describes these as *flexibility*, *simplicity*, *monitoring,* and *enforcement*. The most important consequence of having a flexible market is that the market will be thick—that is, there will be incentives ensuring that most permit transactions are made inside the market.

The last three goals—simplicity, monitoring, and enforcement—are closely related. For the particular case of SO_2 emission control, simplicity means that the emissions of polluting units should be easily measured, and trading rules should be unambiguously stated. Stavins showed that monitoring was successful. Finally, monitoring and enforcement are always costly, but these costs are reduced by simplicity.

The kinds of problem that can plague markets for permits include *market power*, *transaction costs*, *intertemporal trade*, *liquidity*, *noncompliance,* and *correlated externalities.*[55] Market power and noncompliance are closely related topics. By the early 1980s (see Hahn 1984), it was known that when participants in a trading market had some degree of market power, the initial allocation of property rights would affect both the eventual ex post allocation and the degree of noncompliance, unlike the case of competitive markets.[56] Additionally, Malik (2002) shows that market power and noncompliance can be mutually offsetting—in particular, noncompliance of competitive firms diminishes the market power of others; on the other hand, market power is welfare improving when it offsets the noncompliance of competitive firms.

The design of such markets is not a purely technocratic matter but is often influenced by the active participation of citizens, individually and through organizations of civil society. Malueg and Yates (2006) document several cases.[57] They argue that citizens can exert influence in two ways, either by lobbying to modify the initial endowment of permits or quotas, or by directly participating in the trading market. Their theoretical results show that citizen behavior will greatly depend on how property rights entitlements are determined. Under

efficient entitlements citizens will not participate in the trading market, but they will do so if the entitlements are inefficient.[58]

Intertemporal trade and market liquidity are also closely related. The main message from Yates and Cronshaw (2001) and Brechet, Lambrecht, and Prieur (2005) is that forbidding intertemporal trade is like restraining liquidity. In practice not all designed trading pollution markets share the same intertemporal trading regulations; the authors argue that regulation is case-specific.

Environmental problems usually do not occur in isolation. In the last three decades regulation has focused largely on one problem at a time, but in reality pollutants have multiple sources; thus mechanisms conceived to control pollution from a single source are typically incomplete. Caplan and Silva (2005) focus on cases in which negative externalities, such as those that cause global warming or sulphuric acid, are correlated. They propose a control mechanism allowing regional authorities to define their own regulation, while national environmental authorities can achieve coordination by using intraregional income transfers.[59]

ASYMMETRIC INFORMATION

Asymmetric information about product quality

Asymmetric information about the quality of goods provides a clear instance of the potential of market-based solutions to overcome market failures. An important insight is that there are different kinds of asymmetric information, depending on whether and when the hidden information in question ever becomes available. There are goods whose quality can be verified before purchase (perhaps at a cost), goods whose quality can be verified *after* purchase, and goods whose quality *cannot* easily be verified by the consumer even after purchase. Following Tirole (1988), we will call them *"search goods," "experience goods,"* and *"credence goods,"* respectively.[60]

Experience and credence goods will be the focus of this example. The literature on search goods has typically not considered the mere presence of asymmetric information about quality; instead it has focused on the optimal quality level and degree of product diversity. Additionally, as quality can be observed after purchase, firms are usually able to write warranties that consumers understand as quality proxies; the better the insurance, the higher the quality.[61] The main difference between experience and credence goods is that utility losses and gains can be calculated for the former but not for the latter.

Experience goods suffer from agency problems if the relationship between firms and consumers is a short-term one,[62] for instance in the case of restaurants or taxicabs in tourist places. Then, quality is usually provided at a minimal level. Here the problem is one of moral hazard, and the literature has discussed various market-based solutions. If some consumers are informed about quality, the remaining uninformed consumers will mimic the decisions of informed consumers. Policies that increase the proportion of informed consumers will thereby also benefit the uninformed.

When the problem is one of adverse selection rather than moral hazard, the decision faced by firms is not what level of quality to provide but whether to put a good of given quality on the market. Intuition suggests that when prices

do not provide information about quality, firms will put goods on the market only when their quality is low. As a consequence, markets will shrink.

These points are relatively well understood; in what follows we look at examples of market-based solutions that go beyond these familiar strategies.

Certification Mechanisms

It is important to distinguish certification-oriented policies from certification-providing firms. Jin and Leslie (2003) identify under the former heading policies such as *food labeling*, *energy efficiency of new home applications*, *gas mileage of new cars,* and *accounting for publicly traded firms*. Indeed, these government policies provide consumers with valuable information about quality, without which each market is likely to be more limited in its operation. Certification firms can be private or public-sector, or may take any hybrid form. Taking examples from Jin, Kato, and List (2006), we can cite U.S. Educational Testing Services, which provides the SAT; *U.S. News and World Report,* which ranks universities; laboratories that certify the quality of industrial products; Moody's and S&P's, which provide bond ratings; and accounting companies that audit financial reports for public corporations.

The certification industry is important for two reasons. Not only can it provide information to consumers about product quality—it can also provide information to firms about consumers and other firms.

Certification-Oriented Policies

According to Jin and Lesli (2003), compulsory information disclosure through regulation has some clear effects. Besides the natural impact on asymmetric information about the quality of products, there will be an effect on strategic competition between firms. For example, a better knowledge by consumers of product characteristics could intensify competition if products are homogeneous.[63] The authors suggest two additional effects of information disclosure. First, the demand for quality increases. Secondly, firms will expend more resources on improving their quality standards.

Consider the 1997 case of Los Angeles County hygiene report cards.[64] During November 16–18, 1997, CBS broadcast a three-episode report about the hygiene of several L.A. county restaurants, entitled "Behind the Kitchen Door." As a result, by December 16, the L.A. County Board of Supervisors had created a new hygiene regulation for full-service and limited-service restaurants, and by January 16 of 1998 the ordinance was implemented at the county level.

Jin and Lesli (ibid.) found the hygiene report cards ordinance produced several desirable effects. First, restaurants made an effort to increase their annual score, and scores on average improved every year. Second, consumers demanded higher levels of hygiene. Third, authors showed that hospitalizations caused by food-borne illnesses were reduced. Finally, although restaurants were not compelled to make their score public, voluntary disclosure of hygiene scores was remarkably high.

Hygiene report cards were successful for two reasons. The methodology used

for computing the score avoided subjective evaluations, and the standard format allowed consumers easily to verify individual inspection results. Different states in the United States adopted similar measures, given the success of the Los Angeles experiment; however, the details of their application varied from state to state.

The Certification Industry

The literature about this particular industry is quite recent. Lizzeri (1999) shows that a monopolist who is able clearly to identify quality at zero cost will provide a *pass/fail* certification. Guerra (2001) used the same model to show that a monopolist will use another certification method if consumers can observe a noisy proxy for quality: the new method uses a finer grading mechanism, such as *A, B, C*. Finally, Hvide and Heifetz (2001) assume free entry conditions and show that new firms will end up differentiating their grading methods; they also show that in equilibrium the finer the grading method the higher the fee.[65]

Jin, Kato, and List (2006) perform two controlled experiments about how entrants behave and about the information they provide compared with the case of a monopolized industry. The authors find that the new entry will improve information provision under certain conditions.[66]

Information disclosure does not necessarily occur in the same way as with certification-oriented policies.[67] The theoretical literature provides testable predictions about voluntary disclosure: the higher the disclosure costs, the lower the disclosure; higher demand for quality increases disclosure; dispersed consumers' prior beliefs about quality increase benefits from differentiation, thus disclosure increases.[68] Finally, Jin (2005) argues that there is no consensus so far about the impact of competition on a firm's disclosure information decisions; more empirical work is needed on these matters.

Consider the case of the U.S. healthcare system. Now more than half of the U.S. population is enrolled in a managed care plan, whose objective loosely speaking is to organize the provision of health and payment for that service. Among the most important managed care firms we find health maintenance organizations (HMOs), preferred provider organizations (PPOs), and point-of-service plans (POS). Recent empirical studies have analyzed information disclosure by HMOs.

The objectives of HMOs are to reduce the cost of healthcare services for those needing them, and to reduce healthcare expenses for those who pay for the services. HMOs are popular because of their low costs; however, they impose restrictions, such as requiring patients to visit only doctors inside the network, and to use only drugs approved by the healthcare plan.

The National Committee for Quality Assurance (NCQA) was the first, and still remains the most important, verification agency of HMOs.[69] Participation is voluntary; information can be public or private. NCQA provides a wide supply of healthcare quality evaluation services, and also two major data sources. The data sources are: the Health Plan Employer Data and Information Set (HEDIS), and a consumer survey for each participating HMO at the Consumer Assessment of Health Plan Satisfaction (CAHPS). HEDIS and CAHPS are publicly available.

The main concern of Jin (2005) is why not all HMOs voluntarily disclose information to the NCQA.[70] Indeed, Jin shows that by 1998 less than half of all HMOs were voluntarily certified by NCQA. Does competition among HMOs shape the pattern of information disclosure? Jin observed that with few HMOs, firms tried to differentiate as much as they could; consequently, disclosure via NCQA was widespread. But as new HMOs entered into the market, such behavior changed, and HMOs stopped using NCQA as they had previously done. Thus Jin (ibid.) emphasized that the common wisdom about the effect of competition on information disclosure is not always true.

But how valuable is this information? Until recently most researchers have assumed that all revelation of new information would be valuable, but few have attempted to measure the size of the benefits. Jin and Sorensen (2006) conclude that the average value in dollars of new information is modest, but it is still enough to outweigh significantly the costs of collecting and distributing it.[71]

Certification firms and information disclosure can also affect political decisions, as illustrated by the example of the report on "America's Best Colleges" produced by *U.S. News and World Report* (USNWR). Jin and Whalley (2007) show that USNWR reports influence expenditure decisions on public colleges, and also, they argue, reduce political agency problems in the provision of public funds to public colleges. Rankings make it easier to know whether public education funds have been efficiently allocated.

The certification industry faces new challenges in the new economy, with Internet auctions providing a leading example. Jin and Kato (2007) report that auction fraud is the most common offense reported to the FBI's Internet fraud unit. They also conclude that there is no strong correlation between price, quality, and reputation.[72]

Two features help explain these findings. First, eBay's reputation mechanism is not foolproof; Jin and Kato argue that sellers can easily change their identity; identity theft is remarkably common. Secondly, rational sellers can choose to build up a reputation by first using goods whose quality is easy to ensure and that can be easily delivered at low cost; they then can begin dealing in goods whose quality is more costly to ensure, or even selling expensive items that are then not delivered.

The crisis in subprime mortgage lending that unfolded in the summer of 2007 illustrated that the certification industry is not an infallible solution to the problems of asymmetric information that plague the industries certified—for who can certify the certifiers? Credit rating agencies gave ratings to issuers of securitized mortgages that in retrospect were clearly unrealistic; it is too early to tell whether these were indicative of a generalized and systematic set of failings in the credit rating industry, or whether they illustrate merely that no system is perfect. But they do underline the more general message of this chapter that perceptions of market failure are in perpetual evolution, with market development creating new problems even as it alleviates old ones.

Asymmetric information about personal characteristics

In the last three decades another group of markets has received a great deal of attention from both academic economists and policy-makers. Among the

most important are various *insurance markets,*[73] and the *labor market*. In all of these markets, asymmetric information can give rise to problems of two kinds, known collectively as *agency* problems:[74]

- *moral hazard*, when individuals change their behavior as a result of their market transactions (as when insured individuals become less careful to avoid risks), and
- *adverse selection*, when the average behavior of the population of individuals in the market changes (as when low-risk individuals decide not to purchase, leaving only high-risk individuals in the market).[75]

Following Bennardo and Chiappori (2003), the impact of asymmetric information on market outcomes can be analyzed in two ways. In the first, also called the strategic approach (SA), firms acknowledge that they have some market power; consequently strategic interaction becomes a key element of analysis. In the second, called the general equilibrium approach (GEA), firms are too small to affect market outcomes and so take prices as given.

Strategic Approach

General results under the SA are still rare. The most widely used model for this topic is the principal agent model; see Laffont and Martimort (2002); and Bolton and Dewatripont (2005). Among its multiple variants, the multiple-principal multiple-agent formulation is the one that best fits insurance and labor markets. Indeed, in the case of insurance markets one finds multiple firms offering a menu of insurance contracts, and multiple individuals eager to buy insurance. Results in this specific formulation are just starting to emerge.[76]

The first problem is to identify ways to distinguish moral hazard from adverse selection in market data. Chiappori and Salanié (2000) argue that there is a different direction of causality between chosen contracts and the accident probabilities that are observed in the insurance markets.[77] With adverse selection, what explains the empirical observation that different insurance plans are bought by different people is that individuals are not all equally cautious. Thus accident probabilities are a function of individual characteristics. With moral hazard, accident probabilities are the consequence of the incentives embodied in the insurance contracts. Thus estimates of the extent to which variations in accident probabilities can be explained by individual characteristics or the characteristics of contracts provide a good first means of estimating the relative importance of moral hazard and adverse selection in these markets. However, both types of agency problem will lead to positive correlations between the extent of insurance purchased and the risk of accidents, and no distinction can be drawn between them in this regard.[78]

Two main sources of evidence can be brought to bear. The first is natural experiments.[79] They are rare, though, so an important additional way to differentiate between moral hazard and adverse selection is by using panel data.[80] Chiappori (2000) identifies two methods by which this can be done. The first is to assume that all offered contracts in the insurance market are optimal.[81] It is more realistic, of course, to allow for the possibility that contracts are not optimal. The burden of this second method relies on the extra information

required; in particular, researchers need individual level information that is usually difficult to obtain. Chiappori (ibid.) shows that adverse selection and moral hazard effects can be empirically distinguished using the observed behavior of insurance buyers through time. Using French data, Abbring, Chiappori, and Pinquet (2003a) are unable to reject the null hypothesis that there is no moral hazard in automobile insurance. There remains controversy about such findings, though, with Dionne, Michuad, and Dahchour (2004) and Israel (2007) finding significant moral hazard in similar markets using different estimation techniques and different data; still there is no consensus as yet on the appropriate techniques to use, though research is active on ways to derive testable predictions from theory (see Chiappori, Jullien, Salanié, and Salanié (2006)).

General Equilibrium Approach

The objective of most of these studies is to determine the conditions and the nature of a competitive equilibrium under asymmetric information. Prescott and Townsend (1984) showed that under general conditions it is possible to decentralize efficient allocations using the standard competitive equilibrium framework with asymmetric information. In particular, they found that a competitive equilibrium with moral hazard *always* exists, while for economies with adverse selection existence is not guaranteed.

There is also an important body of literature in GEA specialized in moral hazard economies. Helpman and Laffont (1975) were the first to show that a Walrasian equilibrium may not exist under moral hazard, since it may introduce discontinuities in the demand functions. Furthermore, Arnott and Stiglitz (1993) show that equilibria in insurance markets may yield positive profits to firms even though there are no barriers to entry and firms are too small to enjoy any monopoly power.

It makes an important difference whether firms in insurance markets can observe other trades undertaken by insured parties. If they cannot do so, firms will adapt their contracts to take account of the possibility that individuals may have other contracts. Arnott and Stiglitz (1991) argue that firms will offer contracts that are "excessively" large, a prediction that is in principle testable empirically.

Market-based approaches to timing problems

An important type of market is one in which intermediaries match two different types of participant so that each can make transactions. Examples include real estate agencies (matching buyers and sellers), broadcasters (matching viewers and advertisers), and employment agencies (matching employers and employees). Such markets, which we call hereafter two-sided marching markets (TSMM),[82] often suffer from timing problems, in which individuals can seek to "jump the gun" in making contacts with the other side of the market, as many people involved in real estate transactions know from personal experience. Since Roth (1984) there has been a great deal of research effort devoted to studying such phenomena, and in some cases centralized clearinghouses have been established as a means of correcting such market failures.

Not every TSMM requires using clearinghouses. Niederle and Yariv (2007)

provide useful insights using a simple decentralized model in which firms make direct offers to workers. They identify two important factors that determine the outcome of such a process, and consequently the benefits, if any, from the use of a clearinghouse: the way firms make offers to workers, and market participants' information about the preferences of others.

The authors show that the outcome of the bidding process will be stable if firms cannot make exploiting offers, or if workers and firms have complete information. A similar result follows when workers only know their private preferences and firms can make any kind of offer. Under some kinds of asymmetric information, stability will depend on market thickness, with thin (illiquid) markets paradoxically being more likely to be stable than thick ones.

Roth (2008) shows that unstable markets have experienced three kinds of problems that have led them to seek centralized clearinghouse solutions. The first problem is an unraveling in appointment dates. Several examples are cited, notably the market for entry-level positions for North American doctors.

The second problem is seasonal congestion; many matching markets experienced significant delays when processing information during high-volume transaction periods. Finally, and as a consequence of the incentives created by timing problems, many market participants use complex strategies that involve hiding their true preferences, to the detriment of the market's ability to match the different individuals on each side.

What is the impact of using centralized clearinghouses in practice? One of the most cited examples in the literature is the National Resident Matching Program (NRMP) in the United States. Residency is the entry-level position for U.S. doctors; it represents an important step in a doctor's professional career and also provides the main labor force for U.S. hospitals.[83] The residency program was established in 1900, and for the first four decades it worked without a centralized clearinghouse. During this period residency programs and applicants tended to make earlier and earlier job agreements, a problem that was addressed for the first time in 1945. Medical schools agreed to hold applicants' recommendation letters and transcripts until a specific date. But the rules proved too vulnerable to manipulation, and in the early 1950s a centralized clearinghouse was established.

Roth and Xing (1997) have studied the effect of using a similar matching methodology, but one that also decentralizes offers and deadline decisions, in the U.S. market for clinical psychologists. The outcomes from the NRMP and the market for clinical psychologists have been very different, and so therefore has been the strategic behavior of their participants. Roth and Xing show that by imposing a fixed termination date the residency program suffers an important adverse bottleneck. As a consequence, market participants engage in very aggressive behavior: residence programs give applicants just a few minutes to make a decision, and applicants frequently contact their highest-ranked residence programs in advance to convince them that they will accept an offer.[84]

Roth and Xing derive two additional results. First, the higher the correlation between firms' preferences, the more congestion there will be at the beginning of the market, and the longer it will take an applicant to receive an offer. Second, the higher the correlation between applicants' preferences, the fewer

TABLE 14.1

Labor Markets That Adopted the Roth-Peranson Clearinghouse Design after 1998 (and date of first use of a centralized clearinghouse of some sort)

- Postdoctoral Dental Residencies in the United States
  - Oral and Maxillofacial Surgery (1985)
  - General Practice Residency (1986)
  - Advanced Education in General Dentistry (1986)
  - Pediatric Dentistry (1989)
  - Orthodontics (1996)
- Psychology Internships in the United States and Canada (1999)
- Neuropsychology Residencies in the U.S. and Canada (2001)
- Osteopathic Internships in the United States (before 1995)
- Pharmacy Practice Residencies in the United States (before 1994)
- Articling Positions with Law Firms in Alberta, Canada (1993)
- Medical Residencies in the United States (NRMP) (1952)
- Medical Residencies in Canada (CaRMS) (before 1970)
- Specialty Matching Services (SMS/NRMP):
  - Abdominal Transplant Surgery (2005)
  - Child & Adolescent Psychiatry (1995)
  - Colon & Rectal Surgery (1984)
  - Combined Musculoskeletal Matching Program (CMMP)
- Hand Surgery (1990)
  - Medical Specialties Matching Program (MSMP)
- Cardiovascular Disease (1986)
- Gastroenterology (1986–99; rejoined in 2006)
- Hematology (2006)
- Hematology/Oncology (2006)
- Infectious Disease (1986–90; rejoined in 1994)
- Oncology (2006)
- Pulmonary and Critical Medicine (1986)
- Rheumatology (2005)
  - Minimally Invasive and Gastrointestinal Surgery (2003)
  - Obstetrics/Gynecology
- Reproductive Endocrinology (1991)
- Gynecologic Oncology (1993)
- Maternal-Fetal Medicine (1994)
- Female Pelvic Medicine & Reconstructive Surgery (2001)
  - Ophthalmic Plastic & Reconstructive Surgery (1991)
  - Pediatric Cardiology (1999)
  - Pediatric Critical Care Medicine (2000)
  - Pediatric Emergency Medicine (1994)
  - Pediatric Hematology/Oncology (2001)
  - Pediatric Rheumatology (2004)
  - Pediatric Surgery (1992)
  - Primary Care Sports Medicine (1994)
  - Radiology
- Interventional Radiology (2002)
- Neuroradiology (2001)
- Pediatric Radiology (2003)
  - Surgical Critical Care (2004)
  - Thoracic Surgery (1988)
  - Vascular Surgery (1988)

SOURCE: Roth, 2008.

the transactions needed to clear the market, and the fewer incentives for manipulating the rules.

Recently Niederle and Roth (2003) have provided further evidence for the case of Gastroenterology Fellows (GIF). This is an interesting case because a clearinghouse has been adopted twice in the last three decades. Two data sources were used, one coming from the American Medical Association (AMA), and another from the Graduate Medical Education Library.

Using the first data source, Niederle and Roth suggest that,[85] without a clearinghouse, the GIF market becomes thinner, and job placements and employment opportunities decline. They find that after the clearinghouse collapsed in 2000, fellows were more likely to undertake the GIF at the hospital where they had already been residents in internal medicine. Moreover, small programs suffered more than larger programs. Furthermore, using the second data source, the authors conclude that wages in specialties that use the centralized clearinghouse are not significantly lower than those that use a decentralized method, suggesting that centralization does not result in significant hospital buyer power.

Additional studies have documented the effect of unraveling in different markets. Avery, Jolls, Posner, and Roth (2001, 2007) analyze its effect on the market for federal judicial clerks in the United States. Avery, Fairbanks, and Zeckhauser (2003) study college admissions. Recently, Fréchette, Roth, and Ünver (2007) have provided evidence about efficiency gains in the matching of postseason college football games in the United States.

Imposing a centralized clearinghouse does not guarantee that inefficiencies will disappear, since problems may remain in the design or implementation of the matching algorithm. According to Roth (2002), algorithm stability is a key condition for success. Unstable algorithms will be less likely to solve unraveling problems than stable algorithms,[86] since they will create incentives for employment offers to be made outside the clearinghouse.

The most widely known matching algorithm was created by Gale and Shapley (1962) and further developed by Roth and Pearanson (1999); it is known as the *Deferred Acceptance Algorithm* (DAA). This algorithm is now extensively used in different markets, as we show in Table 14.1. Modifications to the original algorithm were implemented based on each application characteristic.[87]

Conclusion: The Achievements and the Future of Market Design

A wide range of markets in a complex modern economy are plagued by market failure, in particular for reasons of externalities and information asymmetries between market participants: industries pollute without taking into account the environmental externalities they cause; fishermen overfish the oceans, consumers face suppliers who provide products of uncertain quality. The remedies may be quite different, but many feature conscious and often ingenious market design.

Whether market design is a more appropriate solution to such market failures than others, such as bypassing of the market by networks and by organizations such as large firms, or regulation of market activity by a government body,

is not something about which general conclusions can be drawn. What we have witnessed in recent times is a surge in the relative popularity of market design. This is partly owing to new technologies such as the Internet, partly also to intellectual developments such as the game theoretic revolution and its offspring, industrial organization and contract theory.

However, it should not be forgotten that the popularity of market design is quite fragile. To the extent that more highly developed markets are also more interlinked and may react more violently to shocks than do less developed but isolated markets, there is the temptation to call for quick fixes when things go wrong. Crucially, any market is embedded in a broader social and political context; wherever there are market failures there will be a public demand for reassurance through regulation. This reassurance is often supplied by politicians, who sometimes offer quick and simple remedies for the failure at the cost of planting the seed of further failures in the future. In a world of imperfect certification, for instance, risk-taking may cause bankruptcies that bring substantial costs to individuals and communities. Bailing out bankrupt firms and entrepreneurs, or subjecting lenders to heavy regulation, may sometimes be the lesser of two evils, but may also create substantial perverse incentives for the future.

In a nutshell, there is a dynamic and quite complex relationship between markets that become more efficient by ingenious design, their potential abuse by equally ingenious entrepreneurs who exploit their operation in pursuit of their own advantage, and the behavior of political entrepreneurs who respond to a shaken belief in markets by advocating restrictive regulation. The topic is beyond the scope of our paper, as it extends into the realm of political economy, but it is important to understand that all the solutions we have highlighted are subject to political constraints and activities, which may correct some failures while typically creating others in the process.

Appendix

TABLE 14.2

Markets That Fit Roth and Xing (1994) Classification

1. Stage 1
   - Market for federal court clerkships
   - Market for new associate positions in large law firms
   - Market for postseason college football bowls
   - MBA graduates of American business schools
   - New professors of marketing in business schools
2. Stage 2
   - Market for new humanities and social-science graduates of elite Japanese universities
   - Market for clinical psychology interns in the U.S.
3. Stage 3
   - Dentistry and optometry
   - Fraternities and sororities
   - Medical specialties
4. Stage 4
   - More medical markets
   - Canadian lawyers

Notes

We are grateful to Rafael Wittek and to the many other participants in the Russell Sage Foundation conference who provided excellent comments and suggestions for improvement. Remaining shortcomings are our own responsibility.

1. We therefore exclude transfers between thieves and their victims, slave-owners and their slaves, and other such involuntary transfers of which history provides lamentably many examples.

2. For evidence of markets in primates, see Kappeler and Van Schaik (2006).

3. The objectives of explaining how markets can work and how markets emerge are not achieved by the same means. While in the former we explain how market outcomes are affected by market imperfections, in the latter we explain the necessary conditions for a particular market to emerge at all. Of course, obstacles that discourage economic agents from participating in a market may also explain why the market works badly, but they are not the only type of explanation.

4. See Levin (2003).

5. By this is meant a type of money accepted by members of the city-state but not necessarily accepted outside the city's perimeter. "External" and "internal" money need not be the same.

6. See Salmon (1999) for a detailed exposition of Greek cities' economic organization.

7. See Britnell (1979) for fairs under King John's rule, and Hodgen (1942) for fairs under Queen Elizabeth.

8. Epstein (1994) argues that most trade had a local or regional basis.

9. Loosely (1933) studies the Puerto Bello fairs that attracted traders from all over the Americas, in particular from Peru, and from as far away as Spain. Betts (1953) documents agricultural U.S. fairs in early nineteenth century, and just like Epstein (1994), suggests that they were a vehicle to economic regional integration; other examples for the United States are Hamilton (1912) and Lemmer (1943). Kendall (1936) studies fairs in the French department of Gers, and Sit (1987) studies the case of China.

10. See Bitros and Karayiannis (2006) for the Delian League.

11. Daenell (1909) cites seventy towns during the fourteenth through fifteenth centuries.

12. Literature about the Hanseatic League goes beyond this chapter's scope. The curious reader could turn to Walford (1881), Palais (1959), and Rotz (1977).

13. Even when a supraregional institution dictates the *right* policies its effect depends on how well agents can make use of them. Carlos, Key, and Dupree (1998) argue that legal changes and changes in property rights law during England's Glorious Revolution were effective because investors already knew how to use them. They argue that the London capital market already provided investors an adequate training in how to make money by exploiting arbitrage, and on how to cover risk using financial tools.

14. "High-grade" use of granular contrasts with "low-grade" and is one of the main components of concrete. The primary difference is that the former is better from an ecological point of view. The conclusions of Vermeulen, Buch, and Greenwood (2007) are threefold. First, market participants will exploit inconsistencies between new policies and existing government structures to entrench the status quo. Second, incumbent market players can create professional associations to lobby in favor of their interests. Third, market rules can become so complex than even market players are unable to understand them. See Buschena and Perloff (1991), who explain how institutional changes during the 1970s in the Philippines coconut oil industry fostered market concentration.

15. See Shiller (2006).

16. See Sunstein and Thaler (2008) for an overview, albeit from two unabashed enthusiasts for such interventions.

17. As will be shown below, the third approach is relatively undeveloped in comparison to the other two.

18. See Saari (1996).

19. A different literature studies Walrasian general equilibrium allocations as the limit of a process not of price formation but of attempts by coalitions of economic agents to cooperate to improve their payoffs with respect to the status quo: the "core" consists of those allocations that no coalition of agents (including the grand coalition of all agents) can improve upon by unilateral action. This enabled important progress to be made in modeling economies without the Walrasian assumption that agents are atomless. Aumann (1964) proved that the core approaches the Walrasian equilibrium when number of traders approaches infinity. This result, though quite robust, may not hold under asymmetric information; see Serrano, Vohra, and Volij (2001).

20. As a referee kindly suggested, we should relate this intermediary with what are known in economic/financial sociology as *security analysts*. According to Zuckerman (1999), security analysts have three features: they represent the main target for investor relation campaigns, they provide recommendations that greatly affect investors' decisions, and they tend to specialize in a particular industry. Notice that these particular intermediaries can affect prices but do not buy the output from the producer to sell on to consumers. On the other hand, Fisher's intermediary (dealer) (1983) serves as a bridge between market participants, and as a consequence obtains a positive rent. Finally, Zuckerman's intermediary (1999) is a special case of Fisher's (1983).

21. In this sort of model agents are provided with software-encoded strategies that govern how to play the game, how to gather information, and how to update their behavior. See Taylor and Jonker (1978) for further details.

22. Gintis argues that having public prices will create too much correlation among agents' decisions, and that is the reason why complex or even chaotic behavior could arise in simple economic systems. If prices are not completely public, agents' decisions will not be *so* correlated and the dynamics will foster desired convergence patterns.

23. Instead of "price system" Gintis uses the term "quasi-public prices" to denote the price distribution emerging after agents, who were assumed to use private-prices, complete their bilateral exchange. We decided not to include the original notation to avoid unnecessary technicalities.

24. See Samuelson and Zhang (1992) for a broader discussion of selection dynamic processes.

25. See Giocoli (2003) and Punzo (2006) for a detailed exposition of Pantaleoni's and Goodwin's contributions.

26. See Chen, Chiarella, Flaschel, and Semmler (2004) for a cleaner and more intuitive version of the model; the novelty is that it is empirically implemented with postwar U.S. data. See also Skott (2006).

27. This model fits into the class of disequilibrium models that were extensively used in the 1960s and 1970s. It is possible to trace recent studies that also use disequilibrium models. See Özdemir and Turner (2008) for a disequilibrium model used to evaluate the role of fiscal discipline in achieving sustained disinflation processes. See Riddel (2004) for a disequilibrium model used to study the U.S. housing market between 1967 and 1998. Finally, see Velupillai (2006) for a macroeconomic disequilibrium model very close to that of Asada et al. (2006).

28. Many studies already have shown how to construct macroeconomic models with explosive or even chaotic dynamics. For recent examples, see Bignami, Colombo, and Weinrich (2004); and Raberto, Teglio, and Cincotti (2006).

29. See Bowles and Gintis (2007) for a comprehensive treatment.

30. There is also evidence that firms in monopoly positions are more likely to be productively inefficient—that is, to operate with higher costs than if they were under competitive pressure.

31. See Motta (2005) for a comprehensive recent treatment.

32. This may include creating markets where none previously existed, as for public procurement, or in such cases as auctions of the radio spectrum for third-generation mobile telephony in a number of countries.

33. See Laffont and Tirole (1996).

34. See Bolton and Dewatripont (2005) for further detail.

35. Details about how quotas were defined and how quota rights can be traded will be explained later in more detail.

36. This is a plain definition of an externality from A. C. Pigou (1932): "Here the essence of the matter is that one person A, in the course of rendering some service, for which payment is made, to a second person B, incidentally also renders services or disservices to other persons (not producers of like services), of such a sort that payment cannot be extracted from the benefited parties or compensation enforced on behalf of the injured parties." For a more formal treatment, see MasCollel, Whinston, and Green (1995).

37. NO_x is a generic label for those gases containing nitrogen and oxygen in different proportions. A usual example of a polluting nitrogen oxide is NO_2, which is responsible for brown/red clouds over urban areas.

38. In the jargon these are known as "non-convexities" in production.

39. See Stavins (1998) for details.

40. See http: //www.epa.gov/airmarkets/resource/docs/marketview.pdf for a brief but detailed synthesis.

41. A similar approach was used for the NO_x emission control program.

42. In particular, most of these electric utility plants were located along the Mississippi River and used coal as input.

43. Chestnut and Mills (2005) document that SO_2 and NO_x contribute to the formation of $PM_{2.5}$, which has proven to be very harmful to human health. Additionally, acid and nitrogen depositions also have proven to be more difficult to eliminate than expected by 1990.

44. *Bankable quotas* in fishing markets are less useful tools because it is hard to predict the amount of fish in a particular area and the composition of future catches.

45. Gordon (1954) provided the first economic approach to the issue of harvesting common-property resources. Recent studies, such as Pascual and Perrings (2007), advocate similar strategies for attaining biodiversity conservation.

46. This example is taken from Newell, Sanchirico, and Kerr (2005). New Zealand's fishing industry represents a small fraction of world supply, but 90 percent of fishing revenues come from exports.

47. By 1986 legislation covered only nine species offshore and seventeen inshore, but by 2004 more than seventy species were covered. Endowments in 1986 were denominated in fixed tonnages, but by 1990 that had changed to a percentage of annual TAC.

48. See Newell, Sanchirico, and Kerr (2005) for a more detailed explanation.

49. A detailed comparison between EU and the U.S. CO_2 emission markets exceeds the scope of this chapter. Interested readers should visit http: //ec.europa.eu/environment/climat/emission.htm.

50. The mineral industry and other industries associated with covering energy activities, production, and processing of ferrous metals, among others.

51. Iceland, Norway, Liechtenstein, and Switzerland.

52. Ison and Wall (2003) analyze the case of traffic-related pollution in the UK.

They conclude that market-based measures are not widely used, for political reasons, so that in reality both market-based and non-market-based policies are implemented. See MacLean and Lave (2003) for a deeper study of traffic-based pollution.

53. Ledyard and Szakaly-Moore (1994), for example, explain two in great detail.

54. See Bolduc (2004) for a reflection about the right way to use market-based instruments, and about the role of details in designing optimal instruments. The author uses the SO_2 emission control problem case. See also Cramton and Kerr (2002), who isolate the case of carbon permit trading organizations and argue that auctions are preferable to grandfathering on efficiency grounds. The authors do not analyze if such a proposal is politically feasible. See Antle et al. (2003) for the case of carbon sequestration in agriculture.

55. Aside from *liquidity* and *correlated externalities*, Malik (2002) provides a brief literature survey on each of these elements. On *market power,* see Hahn (1984); Tietenberg (1985); Van Egteren and Weber (1996); Westskog (1996); and Malueg and Yates (2006). On *transaction costs,* see Tschirhart (1984) and Stavins (1995). On *intertemporal trade,* see Rubin (1996); Cornshaw and Kruse (1996); and Kling and Rubin (1997). On *noncompliance,* see Malik (1990, 1992) and Keeler (1991).

56. Intuitively, this is because firms with market power move too little toward the competitive allocation, selling or buying fewer permits than they need in order to influence the market price in their favor.

57. The first is the SO_2 emission control policy by the U.S. Environmental Protection Agency; the other two are grazing cattle permits in the state of Arizona and on the Grand Canyon plateau.

58. Malueg and Yates (2006) argue that under grandfathering, rather than auctions, citizens will participate in the trading market. See also Smith and Yates (2003) for a model in which citizens participate in the trading market but cannot lobby; they characterize conditions for the optimal property rights endowment.

59. Recall that Roth (2002) argues that market design success depends on understanding the details of each market.

60. See Nelson (1970) for search and experience goods, and Darby and Karni (1973) for credence goods. Let's take the example of a banana. A search good is a banana in *good shape*, meaning a product that seems ready to eat and that seems fresh. An experience good is a banana *produced without pesticides* harmful to human health. And a credence good is a banana produced by a company that *did not engage in unethical behavior toward employees and union representatives*; see http: //news.bbc.co.uk/2/hi/business/6732739.stm.

61. There is a caveat. Full warranties create a moral hazard problem for consumers because they do not internalize the costs of damage claims made by them. Data shows that firms rarely provide full warranties. See Tirole (1988: ch. 2) for a better explanation of the role of warranties.

62. In a dynamic setting analysis is more sophisticated, Tirole (1988) shows how repeated purchases and reputation can partly correct market failures. Agency problems still remain, and moral hazard problems can be outweighed, increasing the number of informed consumers; adverse selection is more subtle and goes beyond this chapter's scope.

63. Sometimes ignorance is a blessing. Imagine the case if information disclosure reveals that goods' characteristics are very different; then, instead of facing tougher competition, each firm could behave as a monopolist.

64. See Jin and Leslie (2003, 2005); and Aguirre et al. (2005) for further details.

65. The theoretical literature goes back, according to Jin, Kato, and List (2006), to Grossman (1981), Milgrom (1981), and Biglaiser (1993). The first two authors study how intermediaries help to make markets attain full information revelation.

66. Welfare is not necessarily increasing in the number of firms in the industry. Beyond a certain number of firms additional firms may not provide benefits that outweigh the costs of entry.

67. Jin and Leslie (2003) documented high rates of voluntary disclosure for the L.A. county hygiene report cards policy.

68. Jin (2005) provides a small survey of empirical studies about disclosure and product differentiation. The interested reader can find the following cases: nutrition labels in the salad dressing market before and after the 1990 U.S. Labeling Act, the motel industry in isolated areas of the United States, supermarkets' quality offer according to geographical proximity, and adoption of magnetic resonance image machines between competing hospitals.

69. The NCQA was founded in 1979 by two managed care associations, becoming independent in 1990 with the help of the Robert Wood Johnson Foundation.

70. There are other firms that provide the same service as NCQA, but in reality this firm is the most important.

71. Jin and Sorensen (2006) compute only direct benefits and ignore indirect benefits such as increased competition between HMOs, so their estimates should be considered lower bounds.

72. In particular, Jin and Kato (2007) perform a controlled experiment using baseball cards. They find that, controlling for successful delivery, quality from reputable sellers is not higher than that from sellers without reputation. This suggests that reputation is mostly about ensuring delivery actually takes place.

73. The most prominent ones are the *automobile insurance market*, the *health insurance market,* and the *life insurance market*.

74. See Bolton and Dewatripont (2005).

75. See Finkelstein and Poterba (2004, 2006) for two recent attempts to test for the presence of adverse selection using observables usually not employed in insurance pricing.

76. See Attar and Chassagnon (2006).

77. See Chiappori and Salanié (1997) for an early survey.

78. Another drawback of using the static approach to asymmetric information is that past events do not affect the correlation between accidents and bought insurance.

79. For example, Dionne and Vanasse (1997) use regulatory changes in 1978 and 1992 in Quebec's automobile insurance market; Fortin et al. (1996) study how Canadian worker's compensation and unemployment insurance programs affect workplace accidents, and Chiappori, Durand, and Geoffard (1998) use regulatory changes in French health insurance markets in 1993. Other natural experiment examples are Dionne and St-Michel (1991); Chiappori, Geoffard, and Kyriadizou (1998); Chiappori and Salanié (1997); and Cardon and Hendel (2001).

80. Or through multiple cross-sections (see Abbring, Chiappori, Heckman and Pinquet 2003a).

81. For example, Dionne and Doherty (1994) use California automobile insurance data to test different theoretical model predictions using insurance firm pricing strategies.

82. The industrial organization literature acknowledges that there is an important relationship between TSMM and two-sided markets; further research is needed to understand this link. For two-sided markets in general, see Rochet and Tirole (2006).

83. See Roth (1984); and Roth and Peranson (1999) for details.

84. Theorem 1 of Roth and Xing (1997) states that without imposing a fixed termination date, the outcomes from the U.S. market for clinical psychologists and the NRMP are the same.

85. See Niederle and Roth (2003) for a detailed analysis.

86. Ünver (2001) showed that even an unstable mechanism can in the long run provide stable matches.

87. Recent applications to the New York City Public School system and Boston Public School system required particular modifications. See Abdulkadiroglu, Pathak, and Roth (2005, 2009) for New York City; and Abdulkadiroglu, Pathak, Roth, and Sonmez (2005, 2007) for Boston. See Erdil and Ergin (2007) for a theoretical approach.

References

Abbring, J. H., P. A. Chiappori, and J. Pinquet. 2003a. "Moral Hazard and Dynamic Insurance Data." *Journal of the European Economic Association* 1, no. 4: 767–820.

———. 2003b. "Testing for Moral Hazard on Dynamic Insurance Data." *Journal of the European Economic Association, Papers and Proceedings* 1, nos. 2–3: 512–21.

Abdulkadiroglu, A., P. Pathak, and A. Roth. 2005. "The New York City High School Match." *American Economic Review, Papers and Proceedings* 95: 364–67.

Abdulkadiroglu, A., P. Pathak, and A. Roth. 2009. "Strategy-proofness versus Efficiency in Matching with Indifferences: Redesigning the NYC High School Match." *American Economic Review* 99: 1954–78.

Abdulkadiroglu, A., P. Pathak, A. Roth, and T. Sonmez. 2005. "The Boston Public School Match." *American Economic Review* 95: 368–71.

———. 2007. "Changing the Boston School Choice Mechanism: Strategy-proofness as Equal Access." Working paper.

Aguirre, A., J. Fielding, P. Leslie, R. Reporter, G. Run, P. Simone, and G. Z. Jin. 2005. "Impact of Restaurant Hygiene Grade Cards on Foodborne-disease Hospitalizations in Los Angeles County." *Journal of Environmental Health* 67: 32–36.

Akerlof, G. 1970. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism." *The Quarterly Journal of Economics* 83: 488–500.

Antle, J., S. Capalbo, S. Mooney, E. Elliott, and K. Paustian. 2003. "Spatial Heterogeneity, Contract Design, and the Efficiency of Carbon Sequestration Policies for Agriculture." *Journal of Environmental Economics and Management* 46: 231–50.

Arnott, R., and J. Stiglitz. 1991. "Equilibrium in Competitive Insurance Markets with Moral Hazard." NBER working paper no. 3588.

———. 1993. "Price Equilibrium, Efficiency, and Decentralizability in Insurance Markets." NBER working paper no. 3642.

Arrow, K. 1959. "Toward a Theory of Price Adjustment." In Moses Abramovitz et al., eds. *The Allocation of Economic Resources: Essays in Honor of Bernard Francis Haley*. Stanford: Stanford University Press

Arrow, K., and J. Debreu. 1954. "Existence of an Equilibrium for a Competitive Economy." *Econometrica* 22: 265–90.

Asada, T., P. Chen, C. Chiarella, and P. Flaschel. 2006. "Keynesian Dynamics and the Ware-price Spiral: A Baseline Disequilibrium Model." *Journal of Macroeconomics* 28: 90–130.

Attar, A., and A. Chassagnon. 2006. "On Moral Hazard and Nonexclusive Contracts." Mimeo. Toulouse School of Economics.

Aumann, R. 1964. "Markets with a Continuum of Traders." *Econometrica* 32: 39–50.

Avery, C., A. Fairbanks, and R. Zeckhauser. 2003. *The Early Admissions Game: Joining the Elite.* Cambridge: Harvard University Press.

Avery, C., C. Jolls, R. Posner, and A. Roth. 2001. "The Market for Federal Judicial Law Clerks." *University of Chicago Law Review* 68: 793–902.

———. 2007. "The New Market for Federal Judicial Law Clerks." *University of Chicago Law Review* 74: 447–86.

Bennardo, A., and P. A. Chiappori. 2003. "Bertrand and Walras Equilibria under Moral Hazard." *Journal of Political Economy* 111, no. 4: 785–817.

Betts, J. 1953. "Agricultural Fairs and the Rise of Harness Racing." *Agricultural History* 27: 71–75.

Biglaiser, G. 1993. "Middlemen as Experts." *RAND Journal of Economics* 24: 212–23.

Bignami, F., L. Colombo, and G. Weinrich. 2004. "Complex Business Cycles and Recurrent Unemployment in a Non-Walrasian Macroeconomic Model." *Journal of Economic Behavior and Organization* 53: 173–91.

Bisin, A., and P. Gottardi. 1999. "Competitive Equilibria with Asymmetric Information." *Journal of Economic Theory* 87: 1–48.

———. 2004. "Moral Hazard and Non-exclusive Contracts." *Rand Journal of Economics* 35: 306–28.

———. 2006a. "Efficient Competitive Equilibria with Adverse Selection." *Journal of Political Economy* 114: 485–516.

———. 2006b. "Decentralizing Efficient Allocations in Economies with Adverse Selection." Mimeo. Universita' Ca' Foscari di Venezia.

Bisin, A., P. Gottardi, and D. Guaitoli. 1999. "A Note on the Convergence to Competitive Equilibria in Economies with Moral Hazard." In *Theory of Markets,* edited by P. J. J. Herings, G. Van der Laan, and A. J. J. Talman, 229–46. Amsterdam: North-Holland.

Bitros, G., and A. Karayiannis. 2006. "Morality, Institutions and Economic Growth: Lessons from Ancient Greece." Munich Personal RePEc Archive Paper no. 994.

Bolduc, S. 2004. "Ceremonial Dimensions of Market-based Pollution Control Instruments: The Clean Air Act and the Cap-and-trade Model." *Utilities Policy* 12: 181–91.

Bolton, P., and M. Dewatripont. 2005. *Contract Theory.* Cambridge: MIT Press.

Bowles, S. 2004. *Microeconomics: Behavior, Institutions and Evolution*. Princeton: Princeton University Press.

Bowles, S., and H. Gintis. 2007. *The Cooperative Species.* Princeton: Princeton University Press.

Brechet, T., S. Lambrecht, and F. Prieur. 2005. "Intergenerational Transfers of Pollution Rights and Growth." Mimeo. Center for Operations Research and Econometrics.

Britnell, R. 1979. "King John's Early Grants of Markets and Fairs." *English Historical Review* 94: 90–96.

Bulow, J., and J. Levin. 2006. "Matching and Price Competition." *American Economic Review* 96: 652–68.

Burdett, K., and M. Coles. 1997. "Marriage and Class." *Quarterly Journal of Economics* 112: 141–68.

Buschena, D., and J. Perloff. 1991. "The Creation of Dominant Firm Market Power in the Coconut Oil Export Market." *American Journal of Agricultural Economics* 73: 1000–1008.

Calvó-Armengol, A., and M. O. Jackson. 2004. "The Effects of Social Networks on Employment and Inequality." *American Economic Review* 94: 426–54.

Caplan, A., and E. Silva. 2005. "An Efficient Mechanism to Control Correlated Externalities: Redistributive Transfers and the Coexistence of Regional and Global Pollution Permits Markets." *Journal of Environmental Economics and Management* 49: 68–82.

Cardon, J., and I. Hendel. 2001. "Asymmetric Information in Health Insurance: Evidence from the National Health Expenditure Survey." *RAND Journal of Economics* 32: 408–27.

Carlos, A., J. Key, and J. Dupree. 1998. "Learning and the Creation of Stock-market Institutions: Evidence from the Royal African and Hudson's Bay Companies, 1670–1700." *Journal of Economic History* 58: 318–44.

Chen, P., C. Chiarella, P. Flaschel, and W. Semmler. 2004. "Keynesian Dynamics and the Wage-spiral: Estimating and Analyzing a Baseline Disequilibrium Approach." Mimeo. Bielefeld University.

Chestnut, L. G., and D. M. Mills. 2005. "A Fresh Look at the Benefits and Costs of the US Acid Rain Program." *Journal of Environmental Management* 77: 252–56.

Chiappori, P. A. 2000. "Econometric Models of Insurance under Asymmetric Information." In *Handbook of Insurance,* edited by G. Dionne, 365–94. Dordrecht: Kluwer Academic Publishers.

Chiappori, P. A., F. Durand, and P.Y. Geoffard. 1998. "Moral Hazard and the Demand for Physician Services: First Lessons from a French Natural Experiment." *European Economic Review* 42: 499–511.

Chiappori, P. A., P.Y. Geoffard, and E. Kyriadizou. 1998. "Cost of Time, Moral Hazard, and the Demand for Physician Services." Mimeo., University of Chicago.

Chiappori, P. A., B. Jullien, B. Salanié, and F. Salanié. 2006. "Asymmetric Information in Insurance: Some Testable Implications." *Rand Journal of Economics* 37, no. 4: 783–98.

Chiappori, P. A., I. Macho, P. Rey, and B. Salanié. 1994. "Repeated Moral Hazard: The Role of Memory, Commitment, and the Access to Credit Markets." *European Economic Review* 38: 1527–53.

Chiappori, P. A., and B. Salanié. 1997. "Empirical Contract Theory: The Case of Insurance Data." *Journal of European Economic Review* 41: 943–50.

Citanna, A., and A. Villanacci. 2000. "Competitive Equilibrium with Moral Hazard in Economies with Multiple Commodities." Mimeo. Universita' di Firenze.

Coase, R. H. 1937. "The Nature of the Firm." *Economica* 4: 386–404.

Coclanis, P. 1993. "Distant Thunder: The Creation of a World Market in Rice and the Transformation It Wrought." *American Historical Review* 98: 1050–78.

Cornshaw, M., and J. B. Kruse. 1996. "Regulated Firms in Pollution Permit Markets with Banking." *Journal of Regulatory Economics* 9: 179–89.

Cramton, P., and S. Kerr. 2002. "Tradeable Carbon Permit Auctions: How and Why to Auction Not Grandfather." *Energy Policy* 30: 333–45.

Daenell, E. 1909. "The Policy of the German Hanseatic League respecting the Mercantile Marine." *American Historical Review* 15: 47–53.

Damiano, E., H. Li, and W. Suen. 2005. "Unraveling of Dynamic Sorting." *Review of Economic Studies* 72: 1057–76.

Darby, M., and E. Karni. 1973. "Fee Competition and the Optimal Amount of Fraud." *Journal of Law and Economics* 16: 67–88.

Demange, G., D. Gale, and M. Sotomayor. 1986. "Multi-item Auctions." *Journal of Political Economy* 94: 863–72.

Dionne, G., and N. Doherty. 1994. "Adverse Selection, Commitment and Renegotiation: Extension to and Evidence from Insurance Markets." *Journal of Political Economy* 102: 210–35.

Dionne, G., P. C. Michaud, and M. Dahchour. 2012. "Separating Moral Hazard from Adverse Selection and Learning in Automobile Insurance: Longitudinal Evidence from France." *Journal of the European Economic Association* (forthcoming)

Dionne, G., and P. St-Michel. 1991. "Worker's Compensation and Moral Hazard." *Review of Economics and Statistics* LXXIII: 236–44.

Dionne, G., and C. Vanasse. 1997. "Une evaluation empirique de la nouvelle tarification de l'assurance automobile (1992) au Québec." *L'Actualité Economique* 73: 47–80.

Epstein, S. 1994. "Regional Fairs, Institutional Innovation, and Economic Growth in Late Medieval Europe." *Economic History Review* 47: 459–82.

Erdil, A., and H. Ergin. 2007. "What's the Matter with Tie-breaking? Improving Efficiency in School Choice." *American Economic Review* 98, no. 3: 669–89.

Finkelstein, A., and J. Poterba. 2004. "Adverse Selection in Insurance Markets: Policyholder Evidence from the U.K. Annuity Market." *Journal of Political Economy* 112: 183–208.

———. 2006. "Testing for Adverse Selection with 'Unused Observables'." NBER working paper 12112.

Fisher, F. 1970. *Disequilibrium Foundations of Equilibrium Economics*. Cambridge, UK: Cambridge University Press.

Fortin, B., P. Lanoie, and C. Laporte. 1996. "Unemployment Insurance and the Durantion of Workplace Accidents." *The Canadian Journal of Economics* 29: S17–S24.

Franciosi, R., R. Isaac, D. Pingry, and S. Reynolds. 1993. "An Experimental Investigation of the Hah-Noll Revenue Neutral Auction for Emissions Licenses." *Journal of Environmental Economics and Management* 24: 1–24.

Fréchette, G., A. Roth, and M. Ünver. 2007. "Unraveling Yields Inefficient Marchings: Evidence from Post-season College Football Bowls." *Rand Journal of Economics* 38, no. 4: 967–82.

Gale, D., and S. Shapley. 1962. "College Admissions and the Stability of Marriage." *American Mathematical Monthly* 69: 9–15.

Guerra, G. 2001. "Certification Disclosure and Informational Efficiency: A Case for Ordered Ranking of Levels." *Oxford Working Paper* No. 64.

Gintis, H. 2006. "The Emergence of a Price System from Decentralized Bilateral Exchange." *Contributions to Theoretical Economics* 6, no. 1, Article 13.

———. 2007. "The Dynamics of General Equilibrium." *Economic Journal* 117, no. 523: 1280–309.

Giocoli, N. 2003. "Structural Change and 'New Facts' in Pantaleoni's Non-equilibrium Dynamics." *Structural Change and Economics Dynamics* 14: 213–36.

Gordon, H. S. 1954. "The Economic Theory of a Common-property Resource: The Fishery." *Journal of Political Economy* 62: 124–42.

Gottardi, P., and B. Jerez. 2006. "A Note on Walrasian Equilibria with Moral Hazard and Aggregate Uncertainty." Mimeo. Universita' Ca' Foscari di Venezia.

Grossman, S. 1981. "The Informational Role of Warranties and Private Disclosure about Product Quality." *Journal of Law and Economics* 24: 461–83.

Hahn, F. 1984. "Market Power and Transferable Property Rights." *Quarterly Journal of Economics* 99: 753–765.

———. 1989. Information Dynamics and Equilibrium. In Hahn, F. (Ed.), *The Economics of Missing Markets, Information, and Game*s. Clarendon Press, Oxford.

Hamilton, J. 1912. "Influence Exerted by Agricultural Fairs." *Annals of the American Academy of Political and Social Science* 40: 200–10.

Hatfield, J., and P. Milgrom. 2005. "Matching with Contracts." *American Economic Review* 94: 913–35.

Heller, W., and D. Starrett. 1976. "The Nature of Externalities." In *Theory and Measurement of Economic Externalities,* edited by Steven A.Y. Lin, 9–22. New York: Academic Press.

Helpman, E., and J. J. Laffont. 1975. "On Moral Hazard in General Equilibrium." *Journal of Economic Theory* 10: 8–23.

Hvide, H. K., A. Heifetz. 2001. "Free-Entry Equilibrium in a Market for Certifiers." Norwegian School of Economics, working paper.

Hodgen, M. 1942. "Fairs of Elizabethan England." *Economic Geography* 18: 389–400.

Holmstrom, B. 1982. "Moral Hazard in Teams." *Bell Journal of Economics* 13: 324–40.

Iizuka, T., and G. Z. Jin. 2005. "The Effect of Prescription Drug Advertising on Doctor Visits." *Journal of Economics and Management Strategy* 14: 701–27.

———. 2007a. "Direct to Consumer Advertising and Prescription Choice." *Journal of Industrial Economics, Notes and Comments* 74, no. 3.

———. 2007b. "Drug Advertising and Health Habits." NBER Working Paper 11770, 2005. Revised.

Ioannides, Y. M., and L. D. Loury. 2004. "Job Information Networks, Neighborhood Effects, and Inequality." *Journal of Economic Literature* 42: 1056–93.

Ison, S., and S. Wall. 2003. "Market- and Non-market-based Approaches to Traffic-related Pollution: The Perception of Key Stakeholders." *International Journal of Transport Management* 1: 133–43.

Israel, M. 2007. "Do We Drive More Safely When Accidents Are More Expensive? Identifying Moral Hazard from Experience Rating Schemes." Wharton School, University of Pennsylvania, working paper.
Jin, G. Z. 2005. "Competition and Disclosure Incentive: An Empirical Study of HMOs." *Rand Journal of Economics* 26: 93–113.
Jin, G. Z., and A. Kato. 2007. "Price, Quality and Reputation: Evidence from an Online Field Experiment." *Rand Journal of Economics.* 37, no. 4: 983–1004.
Jin, G. Z., A. Kato, and J. List. 2006. "That's News to Me! Information Revelation in Professional Certification Markets." Mimeo. University of Maryland.
Jin, G. Z., and P. Leslie. 2003. "The Effect of Information on Product Quality: Evidence from Restaurant Hygiene Grade Cards." *Quarterly Journal of Economics* 118: 409–51.
———. 2005. "The Case in Support of Restaurant Hygiene Grade Cards." *Choices* 20, no. 2: 97–102.
———. 2007. "Reputational Incentives for Restaurant Hygiene." Mimeo. University of Maryland.
Jin. G. Z., and A. Sorensen. 2006. "Information and Consumer Choice: The Value of Publicized Health Plan Ratings." *Journal of Health Economics* 25: 248–75.
Jin, G. Z., and A. Whalley. 2007. "The Power of Information: How Do U.S. News Rankings Affect the Financial Resources of Public Colleges?" Mimeo. University of Maryland.
Jin, G. Z., and L. C. Xu. 2006. "Matching Means and Marriage Quality: Evidence from China." Mimeo.
Kagel, J., and A. Roth. 2000. "The Dynamics of Reorganization in Matching Markets: A Laboratory Experiment Motivated by a Natural Experiment." *Quarterly Journal of Economics* 115: 201–35.
Kappeler, P., and C. Van Schaik, eds. 2006. *Cooperation in Primates and Humans.* Berlin and Heidelberg: Springer.
Keeler, A. 1991. "Noncompliant Firms in TDP Markets." *Journal of Environmental Economics and Management* 21: 180–89.
Kelso, A., and V. Crawford. 1982. "Job Matching, Coalition Formation, and Gross Substitutes." *Econometrica* 50: 1483–504.
Kendall, H. 1936. "Fairs and Markets in the Department of Gers, France." *Economic Geography* 12: 351–58.
Klemperer, P. 2002. "How (Not) to Run Auctions: The European 3G Telecom Auctions." *European Economic Review* 46: 829–45.
Kling, C., and J. Rubin. 1997. "Bankable Permits for the Control of Environmental Pollution." *Journal of Public Economics* 64: 101–15.
Kojima, F. 2007. "Matching and Price Competition: Comment." *American Economic Review* 97, no. 3: 1027–31.
Laffont, J. J., and D. Martimort. 2002. *The Theory of Incentives: The Principle-Agent Model.* Princeton: Princeton University Press.
Laffont, J. J., and J. Tirole. 1996. "Pollution Permits and Compliance Strategies." *Journal of Public Economics* 65: 85–125.
Larre, R. 1969. "Facts of Life about the Integration of National Capital Markets." *Journal of Money, Credit and Banking* 1, no. 3: 319–27.
Ledyard, J., and K. Szakaly-Moore. 1994. "Designing Organizations for Trading Pollution Rights." *Journal of Economic Behavior and Organization* 25: 167–96.
Lemmer, G. 1943. "The Early Agricultural Fairs of Missouri." *Agricultural History* 17: 145–52.
Levin, J. 2003. "Relational Incentive Contracts." *American Economic Review* 93, no. 3: 835–57.
Li, H., and S. Rosen. 1998. "Unraveling in Matching Markets." *American Economic Review* 88: 371–87.

Li, H., and W. Suen. 2000. "Risk Sharing, Sorting, and Early Contracting." *Journal of Political Economy* 108: 1058–91.
Lizzeri, A. 1999. "Information Revelation and Certification Intermediaries." *Rand Journal of Economics* 16: 328–40.
Looseley, A. 1933. "The Puerto Bello Fairs." *Hispanic American Historical Review* 13: 314–35.
MacLean, H., and L. Lave. 2003. "Evaluating Automobile Fuel/Propulsion System Technologies." *Progress in Energy and Combustion Science* 29: 1–69.
Malik, A. 1990. "Markets for Pollution Control When Firms Are Noncompliant." *Journal of Environmental Economics and Management* 18: 97–106.
———. 1992. "Enforcement Costs and the Choice of Policy Instruments for Controlling Pollution." *Economic Inquiry* 30: 387–96.
———. 2002. "Further Results on Permit Markets with Market Power and Cheating." *Journal of Environmental Economics and Management* 44: 371–90.
Malueg, D., and A. Yates. 2006. "Citizen Participation in Pollution Permit Markets." *Journal of Environmental Economics and Management* 51: 205–17.
Mas-Collel, A., M. Whinston, and J. Green. 1995. *Microeconomic Theory.* Oxford, UK: Oxford University Press.
Milgrom, P. 1981. "Good News and Bad News: Representation Theorems and Applications." *Bell Journal of Economics* 12: 380–91.
Miwa, Y., and J. M. Ramseyer. 2006. "Japanese Industrial Finance at the Close of the 19th Century: Trade Credit and Financial Intermediation." *Explorations in Economic History* 43: 94–118.
Motta, M. 2004. *Competition Policy: Theory and Practice*. Cambridge, UK: Cambridge University Press.
Nelson, P. 1970. "Information and Consumer Behavior." *Journal of Political Economy* 78: 311–29.
Newell, R., J. Sanchirico, and S. Kerr. 2005. "Fishing Quota Markets." *Journal of Environmental Economics and Management* 49: 437–62.
Newmark, D., and W. Wascher. 2002. "State-level Estimates of Minimum Wage Effects: New Evidence and Interpretations from Disequilibrium Models." *Journal of Human Resources* 37: 35–62.
Niederle, M. 2006. "Competitive Wages in a Match with Ordered Contracts." NBER working paper no. 12334.
Niederle, M., and A. Roth. 2003. "Unraveling Reduces Mobility in a Labor Market: Gastroenterology with and without a Centralized Match." *Journal of Political Economy* 111: 1342–52.
———. 2009. "The Effects of a Central Clearinghouse on Job Placement, Wages, and Hiring Practices: Gastroenterology Fellows as a Case Study." In *Labor Market Intermediation*, edited by David Autor. Chicago: University of Chicago Press.
Niederle, M., and L. Yariv. 2007. "Matching through Decentralized Markets." Working paper.
Oris, M. 2000. "The Age at Marriage of Migrants during the Industrial Revolution in the Region of Liege." *History of the Family* 5: 391–413.
Ostrovsky, M. 2005. "Stability in Supply Chain Networks." Mimeo. Stanford GSB.
Özdemir, K., and P. Turner. 2008. "A Monetary Disequilibrium Model for Turkey: Investigation of a Disinflationary Fiscal Rule and Its Implications for Monetary Policy." *Journal of Policy Modeling* 30, no. 2: 349–61.
Palais, H. 1959. "England's First Attempt to Break the Commercial Monopoly of the Hanseatic League, 1377–1380." *American Historical Review* 64: 852–65.
Panaccione, L. 2007. "Pareto Optima and Competitive Equilibria with Moral Hazard and Financial Markets." Mimeo. Catholic University of Louvain—CORE.
Pascual, U., and C. Perrings. 2007. "Developing Incentives and Economic Mechanisms

for In Situ Biodiversity Conservation in Agricultural Landscapes." *Agriculture Ecosystems and Environment* 121: 256–68.
Pigou, A. C. 1932. *The Economics of Welfare.* 4th ed. London: Macmillan.
Prescott, E., and R. Townsend. 1984. "Pareto Optima and Competitive Equilibria with Adverse Selection and Moral Hazard." *Econometrica* 52: 21–46.
Punzo, L. 2006. "Towards a Disequilibrium Theory of Structural Dynamics: Goodwin's Contribution." *Structural Change and Economic Dynamics* 17: 382–99.
Raberto, M., A. Teglio, and S. Cincotti. 2006. "A Dynamic General Disequilibrium Model of Sequential Monetary Production Economy." *Chaos, Solutions and Fractals* 29: 566–77.
Riddel, M. 2004. "Housing-market Disequilibrium: An Examination of Housing-market Price and Stock Dynamics 1967–1998." *Journal of Housing Economics* 13: 120–35.
Rochet, J. C., and J. Tirole. 2006. "Two-Sided Markets: A Progress Report." *RAND Journal of Economics* 37: 645–67.
Rosenfeld, B., and J. Menirav. 2001. "Methods of Pricing and Price Regulation in Roman Palestine in the Third and Fourth Centuries." *Journal of the American Oriental Society* 121: 351–69.
Roth, A. 1984. "The Evolution of the Labor Market for Medical Interns and Residents: A Case Study in Game Theory." *Journal of Political Economy* 92: 991–1016.
———. 2002. "The Economist as Engineer: Game Theory, Experimental Economics and Computation as Tools for Design Economics." *Econometrica* 70: 1341–78.
———. 2007. "Repugnance as a Constraint on Markets." *Journal of Economic Perspectives* 21: 37–58.
———. 2008. "Deferred Acceptance Algorithms: History, Theory, Practice, and Open Questions." *International Journal of Game Theory* 36: 537–69.
Roth, A., and E. Peranson. 1999. "The Redesign of the Matching Market for American Physicians: Some Engineering Aspects of Economic Design." *American Economic Review* 89: 748–80.
Roth, A., and X. Xing. 1994. "Jumping the Gun: Imperfections and Institutions related to the Timing of Market Transactions." *American Economic Review* 84: 992–1044.
———. 1997. "Turnaround Time and Bottlenecks in Market Clearing: Decentralized Marching in the Market for Clinical Psychologists." *Journal of Political Economy* 105: 284–329.
Rothschild, M., and J. Stiglitz. 1976. "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information." *Quarterly Journal of Economics* 90: 629–49.
Rotz, R. 1977. "The Lubeck Uprising of 1408 and the Decline of the Hanseatic League." *Proceedings of the American Philosophical Society* 121: 1–45.
Rubin, J. 1996. "A Model of Intertemporal Emission Trading, Banking and Borrowing." *Journal of Environmental Economics and Management* 31: 269–86.
Saari, D. 1996. "The Ease of Generating Chaotic Behavior in Economics." *Chaos, Solitons and Fractals* 7: 2267–78.
Salmon, J. 1999. "The Economic Role of the Greek City." *Greece and Rome* 46: 147–67.
Samuelson, L., and J. Zhang. 1992. "Evolutionary Stability in Asymmetric Games." *Journal of Economic Theory* 57: 363–91.
Schinkel, M., J. Tuinstra, and D. Vermeulen. 2002. "Convergence of Bayesian Learning to General Equilibrium in Mis-specified Models." *Journal of Mathematical Economics* 38: 483–508.
Schmalensee, R., P. Joskow, A. Ellerman, J. Montero, and E. Bailey. 1998. "An Interim Evaluation of Sulfur Dioxide Emissions Trading." *Journal of Economic Perspectives* 12: 53–68.

Seabright, Paul. 2010. *The Company of Strangers: A Natural History of Economic Life.* 2nd ed. Princeton: Princeton University Press.

Serrano, R., R. Vohra, and O. Volij. 2001. "On the Failure of Core Convergence in Economies with Asymmetric Information." *Econometrica* 69: 1685–96.

Shiller, Robert. 2006. *Irrational Exuberance.* 2nd ed. Princeton: Princeton University Press.

Shimer, R., and L. Smith. 2001. "Nonstationary Search." Mimeo. Princeton: Princeton University Press.

Sit, V. 1987. "Urban Fairs in China." *Economic Geography* 63: 306–18.

Skott, P. 2006. "Comments on 'Integrated Keynesian Disequilibrium Dynamics.'" *Journal of Macroeconomics* 28: 131–35.

Smith, S., and A. Yates. 2003. "Optimal Pollution Permit Endowments in Markets with Endogenous Emissions." *Journal of Environmental Economics and Management* 46: 425–45.

Stavins, R. 1995. "Transactions Costs and Tradable Permits." *Journal of Environmental Economics and Management* 29: 133–48.

———. 1998. "What Can We Learn from the Grand Policy Experiment? Lessons from SO_2 Allowance Trading." *Journal of Economic Perspective* 12: 69–88.

Stranlund, J. 2008. "Risk Aversion and Compliance in Markets for Pollution Control." *Journal of Environmental Management* 88*:* 203–10.

Sunstein, Cass, and Richard Thaler. 2008. *Nudge: Improving Decisions about Health, Wealth and Happiness.* New Haven*:* Yale University Press.

Swedberg, R. 2005. "Market in Society." In *The Handbook of Economic Sociology,* edited by N. J. Smelser and R. Swedberg, 233–53. 2nd ed. Princeton, NJ: Princeton University Press.

Taylor, P., and L. Jonker. 1978. "Evolutionarily Stable Strategies and Game Dynamics." *Mathematical Biosciences* 40: 145–56.

Thompson, H. 1960. "Activities in the Athenian Agora: 1959." *Hesperia* 29: 327–68.

Tietenberg, T. 1985. *Emissions Trading: An Exercise in Reforming Pollution Policy*. Washington, D.C.: Resources for the Future.

Tirole, J. 1988. *The Theory of Industrial Organization*. Cambridge, MA: The MIT Press.

Tschirhart, T. 1984. "Transferable Discharge Permits and Profit-Maximizing Behavior." In *Economic Perspectives on Acid Deposition Control*, edited by T. D. Crocker. Boston, M.A.: Butterworth.

Ünver, U. 2001. "Backward Unraveling over Time: The Evolution of Strategic Behavior in the Entry Level British Medical Labor Markets." *Journal of Economic Dynamics and Control* 25: 1039–80.

Van Egteren, H., and M. Weber. 1996. "Market Permits, Market Power, and Cheating." *Journal of Environmental Economics and Management* 30: 161–73.

Velupillai, K. 2006. "A Disequilibrium Macrodynamic Model of Fluctuations." *Journal of Macroeconomics* 28: 752–67.

Vermeulen, P., R. Buch, and R. Greenwood. 2007. "The Impact of Governmental Policies in Institutional Fields: The Case of Innovation in the Dutch Concrete Industry." *Organizational Studies* 28: 515–40.

Walford, C. 1881. "An Outline History of the Hanseatic League, More Particularly in Its Bearings upon English Commerce." *Transactions of the Royal Historical Society* 9: 82–136.

Walras L. 1874. "Principe d'une théorie mathématique de l'échange," *Séances et travaux de l'Académie des sciences morales et politiques (Institut de France),* Collection, 33éme année, nouvelle série, 101: 97–116.

Warburton, D. 2000. "Before the IMF: The Economic Implications of Unintentional Structural Adjustment in Ancient Egypt." *Journal of the Economic and Social History of the Orient* 43: 65–131.

Westskog, H. 1996. "Market Power in a System of Tradable CO_2 Quotas." *Energy Journal* 17: 85–103.

Williamson, O. E. 1970. *Corporate Control and Business Behaviour.* Englewood Cliffs: Prentice Hall.

Yates, A., and M. Cronshaw. 2001. "Pollution Permit Markets with Intertemporal Trading and Asymmetric Information." *Journal of Environmental Economics and Management* 42, no. 1: 104–18.

Zhang, Z. 1999. "Should the Rules of Allocating Emissions Permits Be Harmonised?" *Ecological Economics* 31: 11–8.

Zuckerman, E. 1999. "The Categorical Imperative: Security Analyst and the Illegitimacy Discount." *American Journal of Sociology* 104: 1398–438.