Insights from Experimental Economics for Market Regulation[1]

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Abstract

We present selected results in experimental economics with relevance for market regulation and derive from them concrete insights that could be interesting for regulating authorities. For those readers that are new to experimental economics, the purposes and advantages of economic experiments are discussed and the experimental double-auction market is described in detail to serve as a benchmark example. The experimental results regarding three potential sources of market failure are then outlined: market power, asymmetric information, and externalities. Furthermore, experimental test-bedding, a promising technique for market regulators to examine a new market design ex-ante, is discussed. One important contribution of experimental economics we would like to stress is that the market institution is more important for market outcomes than economic theory has recognized so far.

1. Introduction

Economic theory tells us that under ideal circumstances markets function efficiently and there is little reason for governments to interfere. Theory also identifies several factors which lead to less than ideal circumstances and may hinder an efficient functioning of markets, such as market power and externalities. These insights are an important fundament on which government intervention in markets is or should be based. At the same time, these insights build on some quite strong assumptions. Economic agents are assumed to be perfectly rational, only interested in their own material well-being, and the actions of different agents are assumed to be in equilibrium.

A relatively recent practice is to subject these assumptions and the insights derived from them to experimental tests. The predictions of the theory are compared to the choices made by experimental subjects in controlled laboratory conditions. It turns out that in many environments the theory predicts the choices and outcomes well, while in others the experimental results deviate substantially and

[1] The authors are grateful to Eric van Damme for helpful comments.

systematically from what the theory suggests. In the present report we aim to give an overview of some of the results and insights that can be derived from these experimental studies. The focus will be on insights that are relevant from the perspective of market regulation.

The next section will first discuss the main purposes and advantages of economic experiments. To illustrate how experiments are conducted section 3 will give a description of a double-auction market experiment. This type of experiment was first conducted by Vernon Smith in 1962 and can be marked as the starting point of experimental economics. It is also a good reference point for the sections that follow. Section 4 will present results that deal with the exercise of market power, one of the main sources of market failure. Sections 5 and 6 will discuss results which relate to other types of market failure: asymmetric information and externalities. In section 7 the relatively new practice of experimental test-bedding will be briefly discussed. Much like the testing of scale models of airplanes in a wind tunnel, the idea here is to examine the properties of new designs of markets in a controlled environment. The main difference with the previous two sections is that these tests are much less strictly guided by formal economic theory. Finally, section 8 concludes and outlines some promising areas for further study.

2. Experimental economics

In an economic experiment human subjects make decisions in a setting which is carefully set up for a particular purpose. The two key concepts are observation and control. The experimenter can perfectly observe and document the decisions subjects make, and evaluate the aggregate outcome that results from these decisions. Furthermore, the situation in which the subjects make their choices can be precisely controlled and varied by the experimenter. Just like in experimental physics we do not have to wait for something to happen by accident but we can setup an experimental situation in line with our purposes and observe the consequences.

To appreciate the role of experiments it is useful to give a brief outline of a microeconomic system. Markets are prime examples of such systems. The main elements are the environment and the

institution. The *environment* consists of the economic agents and their characteristics. The agents in a market, for example, are the buyers and sellers and the characteristics are their preferences, resources, and information. The environment determines the structure of supply and demand. The *institution* defines the rules of action and interaction. It specifies who can take which actions, i.e. who can send which messages, and it determines how actions of different agents map into outcomes. For instance, in a first-price sealed-bid auction the number of bidders and their valuation for the good on sale are elements of the environment. The institution is described by the rules of the market, more specifically that all bidders simultaneously submit one bid and that the bidder with the highest bid wins the object and pays her bid to the seller.

Micro-economic models make assumptions about the environment and the institution as well as about the behavior of the agents to derive predictions about the outcome of the system. Typically, it is assumed that agents are rational and self-interested, that is, they maximize their own material well-being. Together with the assumption that the system is in equilibrium – or, equivalently, that agents have rational expectations about the behavior of other agents – this allows theory to make predictions about the outcome of the system.

From a scientific as well as a policy perspective it is important to know whether a theory is "correct". Does it describe and predict the decisions and outcomes accurately? If we want to use field data to examine whether a theory is correct we face important problems. The predictive power of the theory can be assessed only if the assumptions about the environment and institution in the model correspond to those of the field settings to which the theory is applied. In practice we often do not observe all the relevant features of the environment and the institution. For example, to assess the predictions of the competitive market model, we need information regarding the demand and supply

information. Often such data is not available in field con 0s. If the elwdictions of the mode
fail, we can never be sure whether the behavioral assumptions (rational3ty, equilibrium) of
are flawed, or whether the assumptions about the environment and the institution do not corr
those of the field setting.

One main advantage of experiments is that the situation can be controlled. We can set up the environment and the institution in the experiment such that they are in line with the assumptions of the theoretical model. This allows us to examine the predictions of the theory under ideal circumstances. This is what is sometimes called *testing a theory in its own domain*. If under such conditions a theory predicts well this should give us more confidence in the relevance of the underlying behavioral assumptions. For example, to test the competitive market model, we implement an environment which exactly matches the assumptions of perfect information, homogenous goods, etc. This gives us a much sharper test of the behavioral assumptions. In addition, since we know the demand and supply function, we can also directly assess efficiency levels.

Another important advantage is that we can examine an institution in different environments, or conversely, we can study the performance of different institutions in the same environment. In other words, it is possible to honor the *ceteris paribus* clause. This is extremely helpful in order to draw valid conclusions about comparisons and to examine comparative statics predictions.

A final advantage of experiments is that they can generate information about the performance of institutions even in cases in which theory gives little guidance. Some settings are characterized by a multiplicity of equilibria. This is true for example in environments in which the agents face strong coordination problems. Theory often cannot make precise predictions in such settings. Another reason why theory can sometimes not give much guidance is that the environment of interest is simply too complex to be solved theoretically. For example, using auction theory, it is difficult to predict the outcome if the bidders are asymmetric or if there are complementarities between the objects being auctioned. To get insights into the performance of different institutions in spite of these problems, experimental investigations can be very informative. They are not bound by the relative simplicity of the environments which theory can handle.

An important question is whether experimental results can be generalized. There are two issue in regard to this question: The concern that laboratory experiments are too simple relative to the environment of interest in the outside world (environmental validity) and the concern that the chosen subjects are representative (population validity). In regard to the first concern of oversimplification, it

is important to realize that all economic models are abstractions. Thus, whoever citicises experimental economics on these grounds must also criticise economic modelling. However, like economics the main purpose of is to identify the essentials of an environment in order to be able to disregard less important variables. Which variables belong to the essentials depends on the issue under investigation. General theoretical principles (profit maximization, equilibrium, rational expectations) are often tested with rather abstract experimental designs, whereas in the case of test-bed experiments (see section 8) more effort is made to minimize the distance between the experimental design and the specific environment of interest. Moreover, experiments are ideally suited to gradually increase the complexity of the environment (principle of decreasing abstraction). In this way it can be precisely traced which factor is responsible for which change in the observed outcomes.

The second issue of external validity is the choice of experimental subjects (population validity). University students are often used as subjects because they are easily available and have relatively low opportunity costs. But the question is whether their behavior is indicative for that of "real" market participants such as managers. To investigate this question, there are a number of selective replications of experiments using the relevant subjects as participants (traders, managers, professional auction bidders, lobbyists). Even though some differences are found, these studies find that the general patterns of behavior usually correspond remarkably well with those of the student subjects.

At the same time it must be acknowledged that the experimental method, like any method, has its limitations. Experiments are no panacea but a valuable additional source of information. Experimental results are most convincing when they are accompanied by theoretical insights and observations from the field.

3. Double-auction market experiment

In order to illustrate how an experiment is conducted we briefly describe a double-auction market experiment.

Subjects are invited to participate in an economic experiment in which they can earn money. Upon entering the lab, the subjects are assigned to the role of a buyer or a seller. Each seller is informed about his production costs, that is, the costs he incurs when he sells units of the (fictitious) good. The earnings (profits) to a seller when he conducts a trade are equal to the price he receives for his good minus the cost of production. Each buyer is informed about her redemption values, that is, the money that she receives if she manages to buy units of the good. The earnings (consumer surplus) to a buyer when she conducts a trade are equal to her redemption value minus the price she pays for the good.

Trading occurs in accordance with certain institutional rules, which are well-explained to the subjects. Double-auction rules are as follows. Each seller can submit an ask-price to the market, indicating that he is prepared to sell a unit of the good at that price. Each buyer can submit a bid-price to the market, indicating that she is prepared to buy a unit of the good at that price. Asks and bids can be adjusted at any point in time, and are displayed publicly. A trade is conducted when a buyer indicates that she accepts the ask-price of a seller, or when a seller indicates that he accepts the bid-price of a buyer. This process may be repeated for several trading periods in order to allow subjects to learn. Usually, all the interaction takes place over a computer network, but it is also possible to conduct experiments with pen and paper, using a blackboard for the display of public information about offers and prices.

At the end of the experiment, the earnings each individual subject has made on her trades in the different periods are added and paid out in cash. The leading principle here is that subjects do not receive a fixed amount, but rather are paid proportional to their earnings in order to give them real incentives to do as well as they can. Another convention is that average earnings should be at least as high as subjects' opportunity costs of participating. This means that student subjects earn on average some 10-15 Euro per hour. If professionals from the field are used, average earnings are increased accordingly.

The important feature of the experimental market is that we perfectly know and control the environment. This allows us to derive precise theoretical predictions. Under the assumptions of

rationality and price-taking behavior, the marginal cost values of different sellers determine the market supply function. Similarly, the redemption values of the buyers determine the market demand function. Since we know the demand and supply function, we can determine the competitive equilibrium (which is almost never possible in field settings).

The results of hundreds of experiments indicate that, generally, competitive equilibrium is a very good predictor of double-auction market outcomes. Within a couple of trading periods, prices usually converge to the competitive price. Furthermore, it is not just the prices but also the number of trades and the final allocation of the goods, which correspond closely to the competitive equilibrium. This result is very robust to variations in the supply and demand schedule. For example, even if the competitive equilibrium implies that one side of the market earns almost all of the gains from trade, it is remarkable that we can actually observe the competitive outcome in double-auction experiments.

This "success" of economic theory in double-auction markets provides a good benchmark. In the following sections we will discuss whether economic theory is equally successful in predicting experimental results in environments that deviate from this benchmark, i.e., with a potential for market failures.

4. Market power

Market power is the ability of firms to maintain prices at supra-competitive levels, that is, above marginal production costs. As a result, the market will be inefficient. The following section surveys economic experiments evaluating the behavioral relevance of economic theories predicting the exercise of market power.

Result 4.1 The market structure matters, but often differently than expected.

Market power may be explicitly built into the experimental environment in order to investigate whether prices above the competitive level can be sustained in an experimental market. One example

of such designed market power is when one firm can unilaterally and profitably *withhold capacity*. In experiments of this type, supra-competitive prices are often observed. A survey of these studies suggests that, overall, an absence of excess capacity at equilibrium, perfect divisibility of production, and a relatively powerless demand side seem to promote the exercise of market power on the supply side. It must be noted though, that even in these cases, efficiency levels remain relatively high.

An important question addressed by experimental studies is whether a certain minimal *number of firms* is required to obtain competitive outcomes. In monopoly experiments, average prices are well above the competitive price, though often still below the full monopoly level. One important factor seems to be whether buyers can exercise some countervailing power by refusing to buy at very high prices. Other studies compare price-setting markets with two or four equal-sized firms. Here it has been found that four firms are more competitive than two. An increase to more than four firms does not seem to matter much, however. These results suggest that even a relatively small number of firms may be sufficient to introduce competition, at least as long as there are no other anti-competitive factors present.

Some experiments have been conducted on the welfare effects of a change in market structure as the result of a merger. It was found that when market power is held constant a merger increases prices only slightly. This suggests that an increase in concentration as measured by an increase in the Herfindahl-Hirshman Index does not capture market power well.

Finally, the theory of market contestability suggests that in the presence of potential competition markets can be efficient regardless of the number of firms. Experiments indeed show that the addition of an equally efficient potential competitor can increase monopoly efficiency to competitive levels. However, the discipline of potential competition is not as effective when there are sunk-costs of entry, implying that effective potential entry would decrease the likelihood of supra-competitive prices. These results suggest entry barriers should be an important concern for the regulator in addition to the concentration or the number of firms in the market.

Result 4.2 The market institution matters, and more than one would expect.

Many experimental studies have compared *double-auction* markets and *posted-price* markets (as well as several other market institutions).[2] With posted-prices, sellers announce their price offers on a take-it-or-leave-it basis to potential buyers. It is considered to be a good approximation of the pricing process in retail markets. The double-auction is an institution where both sellers and buyers can submit, revise, and accept prices (see section 3). The double-auction is similar to organized exchanges such as the stock exchange. A striking experimental result is that the posted-price markets consistently lead to higher prices and a reduction in market efficiency relative to double-auction markets.[3] Furthermore, double-auctions are much more robust with respect to variations in the market structure. In particular, the exercise of market power is much more curtailed than with posted-prices. This suggests that markets with double-auction type features should raise less regulatory concerns than those with posted-price features.

Another important characteristic of any market institution is the information firms receive about the prices and trades of their competitors. Here, theory gives unclear predictions. On the one hand, transparency may stabilize the market prices and increase efficiency by giving firms more information about the market conditions. On the other hand, more transparency may reduce competitive pressure by giving rivals the possibility to react quickly to each others' price cuts. The experimental evidence on this issue is clearly in support of the latter suggestion. Prices are usually higher with more transparency. It also suggests that so-called 'open-price policies', which are sometimes enacted by trade associations, may be a serious concern. This does not necessarily imply outright collusion, but it certainly means that the incentives to set low (competitive) prices may be seriously impeded.

Result 4.3 Collusion is a relevant concern, and competition policy seems to be on target here.

[2] Many experiments have also examined different one-sided auction formats, such as, first-price sealed bid, second-price sealed-bid, Dutch and English auctions. Here again important performance differences between these institutions are found, even in environments for which theory predicts them to be equivalent.

[3] Note that the theory of the competitive market does not have much to say about the comparison of different market institutions, since its predictions exclusively rely on the market structure.

Experimental evidence supports the theoretical prediction that *repeated interaction* and multi-market contacts facilitate collusion. In multi-period games, repetition with the same cohorts can be observed to increase collusion. But very long sequences do not necessarily lead to more collusion.

Experiments also suggest (again) that institutions are important in determining whether or not collusion will be successful. The effectiveness of non-binding *communication* in inducing cooperation is greatest with posted-prices and differentiated products and least in double-auctions. When given the opportunity to communicate verbally, subjects made use of it. However, in case of the double auction institution, sellers have a strong incentive to defect at the end of the market period. Still, communication in the form that competition law prohibits often leads to collusive outcomes.

In addition, several *contractual provisions* have been found to have a price-increasing effect. For example, practices such as advance-price-notifications (a firm publicly announces price increases well before they are implemented), most-favored-customer clauses (a customer is assured that no other customer will get a lower price), and meet-the-competition clauses facilitate collusive pricing. Much like some open-price policies by trade associations, the main effects of contractual provisions seem to be the improvement of possibilities for tacit coordination and the discouragement of price competition. This suggests that hostility of competition authorities to such contractual provisions may be justified.

A final experimental insight is perhaps surprising. Collusion seems to be more likely when firms experience a negative earnings shock, for example, if they have just paid an entry fee to remain in the market. An explanation for this can perhaps be found in "prospect theory", developed by recent Nobel laureate Daniel Kahneman together with Amos Tversky. This theory suggests that people are more willing to take risks when they find themselves confronted with the prospect of losses. Trying to tacitly coordinate on higher prices may be a risky strategy, but in order to avoid negative outcomes they are more prepared to take the risk.[4]

[4] Generally, there is wide support for prospect theory in individual choice experiments: people often evaluate their position relative to a reference point (e.g., the status quo), they are more concerned about losses than they

5. Asymmetric information

The “lemons market” model by Akerlof suggests that the presence of asymmetric information about quality levels can be a serious impediment to the efficiency of markets. When buyers cannot observe the quality of a good, the price will tend to reflect only the average (expected) quality of the goods offered for sale. This means that sellers with above average quality levels will tend to withhold their goods from the market, which in turn implies that only low quality goods will be traded. This adverse selection theory is closely related to the problem of moral hazard, which suggests that transaction partners will not exert much effort if such effort is not observable.

Results 5.1 Asymmetric information can indeed lead to very inefficient market outcomes.

Several experiments have studied competitive markets, in which only sellers know the quality of the goods they offer for sale. Often very low efficiency levels can be observed, both in markets with exogenous quality (adverse selection), and in markets with endogenous quality (moral hazard). In the moral hazard markets, sometimes *all* the goods traded are of the lowest possible quality. This leads to huge efficiency losses if the potential gains from trade are higher for higher quality goods.

Another insight from these experiments is that most sellers do not seem to have a (moral) problem with selling their products at a much higher price than the true quality level would seem to warrant. Buying at these high prices makes buyer surplus negative when the true quality is low. In these environments, pure price signaling does not seem to solve the problem.

Perhaps even more surprisingly, buyers often tend to trust sellers and to pay much too high prices. With worse experiences this trust decreases, but the tendency of buyers to give sellers the benefit of the doubt does not seem to disappear easily. A possible explanation is that many buyers are overconfident in their ability to distinguish a trustworthy seller from an untrustworthy one.

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care for gains, and they are more prepared to take risks when confronted with losses. Also, as prospect theory

Result 5.2. Repeated purchases, advertising, warranties, disclosure rules, and reciprocity can help to remedy the problem.

In experimental one-shot markets the problem of sellers exploiting buyers' trust is more severe than with multi-period markets. In the presence of repeated purchases, several sellers can try to establish a reputation for being trustworthy, and some try to do so. Several others, however, cannot resist the temptation to 'ripoff' their customers at least occasionally.

When sellers can make announcements about quality, the situation improves somewhat. These announcements help in establishing a reputation and add some credibility to the price signals. Still, many sellers simply lie about the quality level. Again, we also observe that buyers tend to be too trusting with regard to sellers' announcements. When advertising is not merely 'cheap talk' but also allows for signaling (that is, the cost of advertising varies with the quality level) then it helps to restore efficiency to some extent.

More effective is the possibility to issue warranties, which state that the buyer will be repaid when the quality turns out to be lower than announced. Another effective remedy is that disclosure rules are in place, which simply prohibit sellers from making untrue claims about the quality of products. The problem with these remedies is that they often are very difficult to implement and enforce in practice due to the unverifiability of quality levels and other types of transaction costs. This seems especially true for the case of service markets.

A final result is that the possibility for reciprocation may help. When a buyer offers a "good" price, it is more likely that the seller will put in effort to deliver a good product (even in one-shot encounters). This may sound trivial, but from a theoretical perspective it is quite surprising. There is no reason why a selfish seller should vary the quality level with the price offered by the buyer. Also it may seem to be at odds with earlier results that sellers seem to have few problems with cheating. There is an important difference, however. By offering a high price, the buyer is implicitly appealing

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suggests, people are found to use heuristics rather than the laws of statistics to evaluate uncertain events.

to the reciprocity (fairness) of the seller to deliver high quality. Such reciprocity may be particularly relevant for markets in which sellers and buyers interact bilaterally, and price and quality are set sequentially.

6. Externalities

Many important policy questions center around the presence of externalities, that is, environments in which the production or consumption decision of one agent directly affects the well-being of other agents who do not take part in the transaction. These external effects can be either positive (education, development aid, paying taxes, security) or negative (pollution, corruption, over-fishing, speeding). Economic theory suggests that rational agents do not take these externalities into account; in other words, they will free ride. This prediction relies on the assumption that people only care about their own material well-being and are not bound by social norms or a concern for others. Experiments, however, indicate that this assumption needs to be qualified.

Result 6.1. Free riding is real, but not universal.

Clear evidence for this is found in hundreds of public goods experiments. In the most basic setting subjects simply decide whether or not they want to contribute to the provision of a public good. A contribution is costly to the individual, whereas all participants benefit from the contribution. The experiment is usually set up such that the costs of contributing outweigh the benefits for the individual, while for the group as a whole it would be efficient if everyone contributed. The results of these studies indicate that average contribution levels are about halfway between the individually rational level (full free riding) and the socially efficient level (maximum contributions). In conclusion, free riding is certainly a real and relevant phenomenon, but it is not universal.

Another important finding is that the contribution levels vary substantially across individuals. Some individuals always free ride, others contribute more than average. The latter, however, do so conditionally. Typically, they contribute only as long as sufficiently many others do so. That is why they are called 'conditional cooperators'. This may have important policy implications. It suggests that there are strong social and strategic interdependencies between people. It implies that free riding is infectious. As soon as free riding gets a toehold in a population of conditional cooperators, it will tend to spread further because more and more people will start to withdraw their contribution. Preventing this unraveling of cooperation should be an important policy concern. It also implies that people's perception and information about others will be crucial. If people believe that many others pollute, cheat on taxes, or abuse the welfare state, then they are also more likely to do so.

Result 6.2 Free riding varies systematically with factors such as communication, homogeneity, the type of externality, and social sanctioning.[5]

The degree of free riding has been found to vary with different environments and institutions in experiments. First, free riding can be much curtailed when direct *communication* between the participants is possible. Note that this is much less trivial then it may seem. From a theoretical perspective, communication is mere cheap talk and is not expected to make much difference. One possible explanation for the role of communication is that multilateral promising allows participants to enhance trust. Another possibility is that communication fosters group identity, which makes participants more willing to internalize the externalities that their actions impose on the group. Yet another possibility is that communication acts as a coordination device. When there are many conditional cooperators in a group, both 'contributing' and 'not-contributing' can be equilibrium outcomes. Communication may then allow group members to coordinate on the efficient outcomes. From a policy perspective the importance of communication may be a relevant insight.

[5] There are other factors which seem to matter for the extent of free riding, such as target levels, experience, group size, and leadership. Due to space limitations we focus on some of the more important factors.

A second factor, which fosters positive contributions in public goods experiments, is *homogeneity* of potential contributors. The more unequal the members of a group (in terms of costs and benefits), the less likely they seem to contribute to the public good. The reason for this is still not clear. It may be that asymmetries make it more difficult to coordinate on a particular equilibrium. Another possibility is that group identity (social capital) is more difficult to establish when the members of a group are more heterogeneous, a finding which may be important for choosing the appropriate governance level. Furthermore, contributions increase if the members of a group perceive themselves to be in competition with another group. This seems to engender a group feeling and to stimulate people to make efforts to be ahead of other groups.

A third insight is that free riding depends on the *type of externality*. It seems to be more severe for negative externalities than for positive externalities. Theory would predict no difference in this respect: The two types of externalities are just mirror images of each other. However, experimental results suggest that people have a tendency to internalize negative externalities to a much lesser extent than positive externalities. People are more prepared to do something which is good for others, than they are willing to refrain from doing something which is bad for others. This suggests that negative externalities should be a bigger policy concern.

A final insight we wish to mention in this context is that public good provision (or public bad prevention) is much facilitated by the possibility of *social sanctioning*. Participants exhibit a clear willingness to punish other participants if they feel that these free ride too much. These sanctions in turn induce the free riders to reconsider their strategies and increase their levels of contribution. This suggests that externalities will be internalized to a much greater extent in the presence of factors such as peer pressure or social ostracism. Policies could try to use this insight for example by appropriately managing information feedback.

Result 6.3 Incentives matter, but not in trivial ways. Compliance varies in nonlinear ways with monitoring and sanctions.

Experiments indicate that the degree of free riding decreases if the value of the public good increases, or if the cost of contributing decreases. *Incentives* clearly matter. This suggests that the government can issue regulations in order to stimulate the internalization of externalities. For example, the government can set rules such as taxes, speed limits, environmental regulations, and product safety standards. To stimulate compliance, the government can monitor behavior and issue fines or sanctions. Economic theory suggests that the effectiveness of these measures mainly relies on the expected costs of non-compliance, that is, the probability of "being caught" and the size of the sanction.

There is a body of experimental literature which looks at the effectiveness of different enforcement schemes. A first insight is that increasing the monitoring rate is usually much more effective than increasing the size of the sanction. In fact, increasing the size of the sanction is much less effective than economic theory would suggest. A second insight is that the effect of enforcement may interact with the perceived importance of the externality. As we have noted above, many people are willing to contribute voluntarily. They are concerned about the effects which their actions may have on the aggregate outcome, and are motivated to internalize this externality. Experiments indicate that if an enforcement policy is enacted to further stimulate this internalization, then this extrinsic motivation may crowd-out the intrinsic motivation to do so. If the expected size of the monetary fines is quite low then the net effect may even be negative. Studies also indicate that the effects or rewards and punishment will not necessarily be equivalent.

7. Experimental test-bedding

Test-bedding of market institutions is a relatively new field. Like using wind-tunnels to test scale models of airplanes, the purpose is to examine the performance of newly designed institutions under controlled laboratory conditions. Empirical data on the performance of these new institutions is typically not available, and theory is often not developed enough to provide unambiguous answers to

the many design issues that must be solved. At the same time, implementing the "wrong" institution may have important and irreversible consequences. In these cases experiments can be an extremely valuable and relatively cheap source of information.[6]

Experiments have been used, for example, to test-bed different designs for spectrum auctions (Abbink et al. 2001), selling treasury bonds (Abbink et al. 2002), allocating airport landing slots (Güler, Plott, and Vuong, 1994), allocating the use of NASA space stations (Ledyard et al. 1996), matching markets for doctors and hospitals (Roth, 2002), allocating campus housing (Chen and Sonmez, 2002), and deregulating 'public utilities' such as water (Murphy et al, 2000), gas (Rassenti et al, 1994), railroads (Brewer, 2000, Cox et al., 2002), and electricity (Rassenti et al. 2002). Often, these experiments are commissioned by the government and tailored to the relevant specifics of demand and supply of the market in question. Space limitations preclude that we present the results of several of these studies. It seems more useful to give a gist of these studies by presenting some details about one of such test-bedding projects.

To regulate pollution levels, several countries have taken initiatives to replace a system of command-and-control (quotas, standards) with a system of tradable emission permits. The principle underlying these initiatives goes back to the Coase theorem. If property rights can be assigned to an externality then decentralized trading can ensure that the externality will be internalized in an efficient way. The market will ensure that the rights end up in the possession of those who value them most. A crucial assumption for the Coase theorem to apply is that transaction costs are low, that is, costs of search, coordination, bargaining, and enforcement are low. Otherwise, these transactions costs would preclude that all profitable trades are realized. The question, how to ensure that the market is characterized by low transaction costs and leads to efficient prices, is a delicate design question, which theory cannot readily solve.

Result 7.1. Emissions markets can work well, but again institutions matter.

[6] Another role of economic experiments can be to demonstrate theoretical results, i.e., that a certain institutional change 'really' leads to important benefits. Plott (1987) for example reports that their experimental

Overall, experiments found that trading allows for significant increases of efficiency over the initial allocation of emission permits. Markets allow a reduction in abatement costs relative to those incurred under a command-and-control regime. Moreover, in several environments the prices tend toward the competitive level. At the same time, efficiency gains are found to depend significantly on the market institution being used. For example, the Environmental Protection Agency in the US first used a discriminative two-sided auction to allocate the permits. This means that sellers with the lowest ask-prices are matched with those buyers who have the highest bid-prices. This institution was partly designed to reduce distributional consequences. Experiments, however, indicate that this institution leads to substantial efficiency losses, because it gives sellers an incentive to under-reveal their true valuation. Furthermore, it is shown that this deficiency can be quite easily remedied by using a uniform price market institution at little cost to the equity concerns. Several other design features are found to affect the performance of the market such as the possibility of permit banking, and permit trade after the initial allocation.

Result 7.2 The presence of market power may seriously hamper the efficiency of permit trading.

When the demand or supply side of the permit market is characterized by market power due to the presence of one or more dominant players, prices can be driven away from the competitive level and create serious efficiency losses. In some environments, the outcome is even worse than under a command-and-control regime. These efficiency losses not only occur because abatement levels are suboptimal, but also because the downstream market is distorted. Players who dominate the permit market can drive up the cost of their rivals to obtain permits and put them at a disadvantage in the product market. This could imply, for example, that we do not only have inefficient pollution levels but also distorted emission permit prices.

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demonstrations of the efficiency gains of airport slot auctions were much more persuasive than their theoretical arguments.

Unlike many experiments in the studies discussed in the previous sections, test bedding experiments are not set up mainly to test the general robustness of theoretical models or to examine universal behavioral assumptions. Therefore, given the limited amount of test bed experiments and their very specific focus of interest, it is difficult to draw general conclusions. If there is one general insight it is perhaps that "the devil is in the detail." Seemingly small variations in the design of a market can have large consequences. On a more positive note, however, many of these studies show that more market-oriented policies can lead to large efficiency gains *with the appropriate design*.

8. Conclusion and prospects

Economic experiments have shown that, under the conditions specified by the competitive model, markets can work extremely well and can lead to very efficient outcomes. One could say that this means a success for both the free market and the theory. However, experiments have also identified several environments which may lead to inefficient market outcomes when there was no match between theory and experimental observations. This mismatch of experimental and theoretical results, when it occurs, gives significant feedback to economics: For example, while the importance of the market structure seems to be somewhat over-stressed, the importance of the market institution is under-valued by the theory. Furthermore, experimental evidence suggests that people are intrinsically motivated by concerns such as fairness and reciprocity, and that they are affected more by gains than by losses. Even though it is not straightforward to derive 'general' policy implications, we believe these insights should not be discarded lightly.

What are promising prospects for experimental inquiry in relation to market regulation? First, we believe that more attention should be paid to the role of the market institution. For example, in the deregulation of the taxi market experimental inquiry could inform the discussion about efficient pricing rules. Should taxi-drivers be forced to post prices on their cab, should they be allowed to give discounts on these prices, should the price be negotiated between driver and customer, or should the (maximum) price be regulated? Furthermore, should these pricing rules be uniform or should different

rules apply to different types of customers? We believe that this type of question is very well suited for experimental inquiry. This could - and should - be done, taking the specifics of demand and supply of the taxi-market into account, including potential market failures (quality, entry barriers, externalities).

Second, competition authorities often have to rule on practices which have ambiguous welfare implications. For example, resale price maintenance in the market for books may curtail certain free-riding problems for retailers (such as, providing good service and carrying a large assortment). At the same time, this practice may also be used as a collusion device. We believe that economic experiments are an excellent instrument to assess the likely welfare effects of this type of contractual practices.

A final set of policy questions, which could be informed by experiments, is how to stimulate compliance with rules and regulations. As we have seen, economic theory seems to overstate the importance of material incentives such as fines, and undervalue the role of social norms and intrinsic motivations. An important issue will be to design institutions of monitoring and enforcement which "cash in" on these intrinsic motivations and stimulate the role of social norms. It is not likely that we will find a uniform design that will be optimal across different environments. This will depend on factors such as the type of externality (positive or negative), the level of governance (local or national), the role of risk (losses versus gains), and the possibilities for communication and monitoring. And it is precisely these types of factors that can be taken into account in economic experiments.

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