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MARKET FAILURE

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ABSTRACT

Market failure is described and discussed. A summary of the current state of understanding is provided. Key words are: market failure, public good, externalities, rational expectations, information, monopoly, and competitive equilibrium.

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The best way to understand market failure is first to understand market success, the ability of a collection of idealized competitive markets to achieve an equilibrium allocation of resources which is Pareto-optimal. This characteristic of markets, which was loosely conjectured by Adam Smith, has received its clearest expression in the theorems of modern welfare economics. For our purposes the first of these, named the First Fundamental Theorem of welfare economics, is of most interest. Simply stated it reads: (1) if there are enough markets, (2) if all consumers and producers behave competitively, and (3) if an equilibrium exists, then the allocation of resources in that equilibrium will be Pareto-optimal. (See Arrow [1951] or Debreu [1959].) Market failure is said to occur when the conclusion of this theorem is false, that is, when the allocations achieved with markets are not efficient.

Market failure is often the justification for political intervention in the marketplace. (For one view see Bator [1958], Section V.) The standard argument is that if market allocations are inefficient everyone can and should be made better off. To understand the feasibility and desirability of such Pareto-improving interventions, we must achieve a deeper understanding of the sources of market failure. Since each must be due to the failure of at least one of the three conditions of the First Theorem, we will consider those conditions one at a time.

The first condition requires there to be enough markets. Although there are no definitive guidelines as to what constitutes "enough," the general principle is that if any actor in the economy cares about something that also involves an interaction with at least one other actor, then there should be a market for that something; it should have a price (Arrow [1969]). This is true whether the something is consumption of bread, consumption of the smoke from a factory, or the amount of national defense. The first of these examples is a standard private good, the second is an externality, and the third is a public good. All need to be priced if we are to achieve a Pareto-optimal allocation of resources; without these markets, actors may be unable to inform others about mutually beneficial trades which can leave both better off.

The informational role of markets is clearly highlighted by a classic example of market failure analyzed by Scitovsky [1954]. In this example, a steel industry, which must decide *now* whether to operate, will be profitable if and only if a railroad industry will begin operations within five years. The railroad industry will be profitable if and only if the steel industry is operating when the railroad industry begins its own operations. Clearly each cares about the other and it is efficient for each to operate; the steel industry begins today and the railroad industry begins later. Nevertheless, if there are only spot markets for steel, the railroad industry cannot easily inform the steel industry of its interests through the marketplace. This inability to communicate desirable

interactions and to coordinate timing is an example of market failure and has been used as a justification for public involvement in development efforts: a justification for national planning. However, if we correctly recognize that there are simply too few markets, we can easily find another solution by creating a futures market for steel. If the railroad industry is able to pay today for delivery of steel at some specified date in the future, then both steel and railroad industries are able to make the other aware of their interests through the marketplace. It is easy to show that as long as agents behave competitively and equilibrium exists the addition of futures markets will solve this type of market failure.

A completely different example of the informational role of markets arises when actors in the marketplace are asymmetrically informed about the true state of an uncertain world. The classic example involves securities markets where insiders may know something that outsiders do not. Even if it is important and potentially profitable for the uninformed actor to know the information held by the informed actor, there may not be enough markets to generate an efficient allocation of resources. To see this most clearly suppose there are only two possible states of the world. Further suppose there are two consumers, one of whom knows the true state and one of whom thinks each state is equally likely. If the only markets that exist are markets for physical commodities, then the equilibrium allocation will not in general be Pareto-optimal. One solution is to create a contingent claims market. An "insurance" contract can be created in which delivery and acceptance of a specified amount of the commodity is contingent on the true state of the world. Assuming both parties can, ex post, mutually verify which is indeed the true state of the world, if both behave competitively and an equilibrium allocation exists, it will be Pareto-optimal, given the information structure. A more general and precise version of this theorem can be found in Radner [1968].

Analyzing this example further we note that in equilibrium the prices of commodities in the state which is not true will be close to or equal to zero, since at positive prices the informed actor will always be willing to supply an infinite amount contingent on the false state, knowing delivery will be unnecessary. If the uninformed actor is clever and realizes that prices will behave this way in equilibrium then he can become informed simply by observing which contingency prices are zero. If he then uses this information which has been freely provided by the market, the equilibrium will be Pareto-optimal under full information. In a very simple form this is the idea behind rational expectations (see Muth [1961]). With clever competitive actors it may not be necessary to create all markets in order to achieve a Pareto-efficient equilibrium allocation.

Completing markets seems to be an easy technique to correct market failure. The suggestions that taxes and subsidies (Pigou [1932]) or property rights reassignments (Coase [1960]) can cure market failure follow directly from this observation. However, an unintended consequence can sometimes occur after the creation of these markets. In some cases adding more markets may cause conditions (2) and (3) of the First Theorem to be false. Curing one form of market failure can lead to another. To understand how this happens and how the second condition requiring competitive behavior can be affected consider the informed consumer in our previous example. If he realizes that the uninformed consumer is going to make inferences based indirectly on his actions, then he should not behave competitively because he could do better by pretending to be uninformed. He can, by strategically limiting the supply of information of which he is the monopoly holder, do better than if he behaved competitively. It is only his willingness to supply infinite amounts of the

commodity in the false state that gives away his knowledge. Supplying only a little commodity contingent on that (false) state in return for a small payment *today* would not allow the uninformed agent to infer anything and would allow the informed agent to make a profit from his monopoly position. This is not very different from the standard example of a violation of condition (2), monopoly supply of a commodity.

A different example of this phenomenon of unintended outcomes arises when markets are created to allocate public goods. It is now well known that the introduction of personal, Lindahl prices to price individual demands for a public good does indeed lead to Pareto- optimal allocations if consumers behave competitively (see Foley [1970]). However, under this scheme, each agent becomes a monopsonist in one of the created markets and, therefore, has an incentive to understate demand and not to take prices as given. This is the phenomenon of "free riding," often alluded to as the reason the creation of markets may not be a viable solution to market failure. To understand why, let us now examine the second condition of the First Theorem in more detail.

The second condition of the First Theorem about market success is that all actors in the marketplace behave competitively. This means that each must act as if they cannot affect prices and, given prices, as if they follow optimizing behavior. Consumers maximize preferences subject to budget constraints and producers maximize profits, each taking prices as fixed parameters. This condition will be violated when actors can affect the values that equilibrium prices take and in so doing be better off. The standard example of market failure due to a violation of this condition is monopoly in which one actor is the sole supplier of an output. By artificially restricting supply this actor can cause higher prices and make himself better off even though the resulting equilibrium allocation will be inefficient.

Can we correct market failure due to non-competitive behavior? To find an answer let us first isolate those conditions under which agents find it in their interests to follow competitive behavior. The work of Roberts and Postlewaite [1976] has established that if each agent holds only a small amount of resources relative to the aggregate available, then they will usually be unable to manipulate prices in any significant way and will act as price takers. It is the depth of the market that is important. This is also true when the commodity is *information*. If each agent is informationally small, in the sense that they either know very little or what they know is of little importance to others, then they lose little by behaving competitively. (See Postlewaite and Schmeidler [1986].) On the other hand, if they are informationally important, as in the earlier example, they may have an incentive to behave non-competitively. The key is the size of the agent's resources, both real and informational, relative to the market.

The solution to market failure from non-competitive behavior then seems to be to ensure that all agents are both *resource* and *informationally* small. Of course this must be accomplished through direct intervention as in the anti-trust laws and the securities market regulations of the United States and may not be feasible. For example, it may not be possible to correct this type of market failure by simply telling agents to behave competitively. In such an attempt, one would try to enforce a public policy that all firms must charge prices equal to the marginal cost of output. But, unless the costs and production technology of the firm can be directly monitored, a monopolist can easily act as if he is setting price equal to marginal cost while using a false cost curve. It would be impossible for an outside observer to distinguish this non-competitive behavior from competitive behavior without

directly monitoring the cost curve. If the monopolist were a consumer whose preferences were unobservable, then even monitoring would not help. In general, market failure from non-competitive behavior is difficult to correct while still retaining markets. We will hint at some alternatives below.

Expansion of the number of markets can also lead to violations of the third condition of the First Theorem. For illustration we consider three examples. The first and simplest of these is the case of increasing returns to scale in production. The classic case is a product which requires a fixed set-up cost and a constant marginal cost to produce. (More generally we could consider non-convex production possibilities sets.) If the firm acts competitively in this industry and if the price is above the marginal cost the firm will supply an infinite amount. If the price is at or below marginal cost the firm will produce nothing. If the consumers' quantity demanded is positive and finite at a price equal to marginal cost, then there is no price such that supply equals demand. Equilibrium does not exist. The real implication of this situation is not that markets do not equilibrate or that trade does not take place, it is that a natural monopoly exists. There is room for at most one efficient firm in this industry. Again it is the assumption of competitive behavior which is ultimately violated.

The next example, due to Starrett [1972], involves an external diseconomy. Suppose there is an upstream firm that pollutes the water and a downstream firm that requires clean water as an input into its production process. It is easy to show that if such a diseconomy exists and if the downstream firm always has the option of inaction (i.e., it can use no inputs to produce no outputs at zero cost), then the aggregate production possibilities set of the economy when expanded to allow enough markets cannot be convex. (See Ledyard [1976] for a formal proof.) If the production possibilities set of the economy is non-convex then, as in the last example, it is possible that a competitive equilibrium will not exist. Expansion of the number of markets to solve the inefficiencies due to external diseconomies can lead to a situation in which there is no competitive equilibrium.

The last example, first observed by Green [1977] and Kreps [1977], arises in situations of asymmetric information. Recall the earlier example in which one agent was fully informed about the state of the world while the other thought each state was equally likely. Suppose preferences and endowments in each state are such that if both know the state, then the equilibrium prices in each state are the same. Further, suppose that if the uninformed agent makes no inferences about the state from the other's behavior then there will be different prices in each state. Then no (rational expectations) equilibrium will exist. If the informed agent tries to make inferences the prices will not inform him, and if the uninformed agent does not try to make inferences the prices will inform him. Further, it is fairly easy to show that if a market for information could be created (ignoring incentives to hide information) the resulting possibilities set is in general non-convex. In either case there is no equilibrium.

Most examples of non-existence of equilibrium seem to lead inevitably to non-competitive behavior. In our example of non-existence due to informational asymmetries, it is natural for the informed agent to behave as a monopolist with respect to that information. In the example of the diseconomy, if a market is created between the upstream and the downstream firm, each becomes a monopoly. If there is a single polluter and many pollutees, the polluter holds a position similar to a monopsony. The non-existence problem due to the fundamental non-convexity caused by the use of markets to eliminate external diseconomies is simply finessed by one or more of the participants

assuming non-competitive behavior. An outcome occurs but it is not competitive and, therefore, not efficient.

Market failure, the inefficient allocation of resources with markets, can occur if there are too few markets, non-competitive behavior, or non-existence problems. Many suggested solutions for market failure, such as tax-subsidy schemes, property rights assignments, and special pricing arrangements, are simply devices for the creation of more markets. If this can be done in a way that avoids non-convexities and ensures depth of participation, then the remedy can be beneficial and the new allocation should be efficient. On the other hand, if the addition of markets creates either non-convexities or shallow participation, then attempts to cure market failure from too few markets will simply lead to market failure from monopolistic behavior. Market failure in this latter situation is fundamental. Examples are natural monopolies, external diseconomies, public goods, and informational monopolies. If one wants to achieve efficient allocations of resources in the presence of such fundamental failures one must accept self-interested behavior and explore non-market alternatives. A literature using this approach, sometimes called *implementation theory* and sometimes called *mechanism design theory*, was initiated by Hurwicz [1972] and is surveyed in Groves and Ledyard (1986).

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