THE DEATH OF ECONOMICS

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The world economy is in crisis. Unemployment in Western Europe rises towards the 20 million mark. America faces the deep-seated problem of the twin deficits, the federal budget and the balance of trade. Vast tracts of the former Soviet empire are on the brink of economic collapse. Japanese companies, faced by the deepest recession since the war, are on the verge of breaking the long-standing and deep-rooted social convention of lifetime employment.

The orthodoxy of economics, trapped in an idealised, mechanistic view of the world, is powerless to assist.

In Western Europe, the economics profession eulogised the Exchange Rate Mechanism and monetary union, despite frequent bouts of massive currency speculation and the inexorable rise of unemployment throughout Europe during its years of existence. Teams of economists descend on the former Soviet Union, proclaiming not just the virtues but the absolute necessity of moving to a free-market system as rapidly as possible. Such prescriptions involve the establishment of market economies of greater purity than those contemplated by Ronald Reagan and Margaret Thatcher. But despite governments in the former Soviet bloc doing everything they are told, their economic situation worsens.

From the pensioned security of their vast bureaucracies, economists from the International Monetary Fund and the World Bank preach salvation through the market to the Third World. Austerity and discipline are the hallmarks of the favoured policies of the IMF throughout the world, yet its own salary bill has risen by 38 per cent in the last two years, and is budgeted to rise by a further 22 per cent in 1994.

On a more mundane level, economic forecasts are the subject of open derision. Throughout the Western world, their accuracy is appalling. Within the past twelve months alone, as this book is being written, forecasters have failed to predict the Japanese recession, the strength of the American recovery, the depth of the collapse in the German economy, and the turmoil in the European ERM.

Yet to the true believers, within the profession itself, the ability of economics to understand the world has never been greater. Indeed, in terms of influence in the world the standing of the profession appears high. Economics dominates political debate, to the extent that it is scarcely possible to have a serious political career in many Western countries without being able to repeat more or less accurately its current fashionable orthodoxies. Television seeks out the views of economists on Wall Street and in the City of London, anxious that the viewing public should be informed of the impact of the latest

monthly statistic on the entire economy over the coming years. The numbers of students seeking to read economics grew dramatically during the 1980s.

Academically, the discipline seems to have developed enormously, particularly over the past decade, the mathematical sophistication especially having increased in terms both of theoretical work and of the approved methodologies of applied economics.

Of course, disputes still exist, such as the well publicised arguments between monetarists and Keynesians as to how the economy as a whole operates. For example, the former argue that increases in government expenditure will ultimately have no impact on the overall level of economic activity and employment. Both sides agree that such increases can have a positive effect on a time horizon of two or three years. Keynesians believe that some of this impact persists. But such tiffs merely conceal the large body of shared belief which characterises present-day economics. The old joke that twelve economists in a room could be guaranteed to hold twelve different opinions, and thirteen if one of them were Keynes, is becoming less and less true. An intellectual orthodoxy has emerged.

Increasingly, the subject is taught not as a way of learning to think about how the world *might* operate, but as a set of discovered truths as to how the world *does* operate. The content of degree courses is becoming increasingly standardised. Substantial and impressive textbooks exist, both in micro- and in macro-economics, consisting in the main of the mathematical technique of differential calculus applied to linear systems.

It cannot be stated too often that very little of the content of such textbooks is known to be true, in the sense that many of the statements in textbooks on, say, engineering, are known to be true: formulae for building bridges exist, and when these formulae are applied in practice, bridges in general remain upright. The same does not apply in economics and yet the confidence of the true believers in economics has grow'd and grow'd like Topsy. As they themselves would doubtless prefer to say, to give the description an authentic mathematical air, it has grown exponentially.

Sociologists and psychologists have documented many case studies concerning the reactions of groups when views which they hold about the world are shown to be false. In such situations, far from recognising the problem, a common reaction of individuals is to intensify the fervour of their belief.

A classic study of this kind, *When Prophecy Fails*, published in 1956, was carried out by American psychologists. It describes the experiences of researchers who joined a group which was making specific predictions of imminent catastrophic floods. When the floods failed to appear, the group, far from disbanding, intensified enormously its efforts to convert others to its beliefs. Another example is provided by James Patrick, a young sociologist who infiltrated a gang of Glasgow youths in the late 1960s. These gangs, while being almost model citizens by the standards of the American inner city, were notorious for perpetrating acts of violence, mainly on each other but occasionally on the public at large, which were thought extreme in Northern Europe. The gang believed as a

point of honour that no member would betray another to the police. Yet, as the author noted:

> "One prominent member of the gang was arrested and within twenty-four hours all other members had been questioned by the police. The inference was obvious to everyone except the gang. Yet their misplaced belief in gang loyalty was not discarded or even diminished, but became all the more extreme and passionate."

The intensity of faith shown by most professional economists is well illustrated by two passages from Liars Poker by Michael Lewis, who began his career as a successful trader on world capital markets. His descriptions of how such markets operate are in many ways far removed from the received wisdom of orthodox economics. The first passage deals with the aspect of the growth of economics as a discipline. Writing about the major US universities in the mid-1980s, Lewis states:

> "[An effect] which struck me as tragic at the time was a strange surge in the study of economics. At Harvard, the enrolment had tripled in ten years. At Princeton, in my senior year, for the first time in the history of the school, economics became the single-most popular area of concentration. And the more people studied economics, the more an economics degree became a requirement for a job on Wall Street. There was a good reason for this. Economics satisfied the two most basic needs of investment bankers. First, bankers wanted practical people, willing to subordinate their education to their careers. Economics seemed designed as a sifting device. Economics was practical. It got people jobs. And it did this because it demonstrated that they were among the most fervent believers in the primacy of economic life.
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> "Economics allowed investment bankers directly to compare the academic records of the recruits. The only inexplicable part of the process was that economic theory (which is what, after all, economics students were supposed to know) *served almost no function in an investment bank."*

In other words, at the very centre of world financial markets, where the principles of the free market should be at their clearest, economics as an intellectual discipline served almost no practical function.

The second example from Lewis's book provides even more food for thought, both as an intellectual challenge for economics and as an illustration of how the study of the subject can affect a person's mind. A fundamental belief in economics for many years has been that the price of a commodity — whether it is bananas or people — is determined by the relative levels of demand and supply. The higher the demand relative to supply, the higher the price.

At an early stage in Lewis's career on Wall Street, during his training programme, a group of his colleagues was asked why they were so well paid. "A person who had just taken an MBA from the University of Chicago explained: 'It's supply and demand. My sister teaches kids with learning disabilities, and earns much less than I do. If nobody else wanted to teach, she'd make more money.'" In fact, as all the trainees were acutely aware, there had been intense competition to secure places on their programme. Over 6000 people, most of them from economics programmes at the major American

universities, had applied for just 127 places on the Salomon Brothers'training programme. Yet as Lewis drily remarks: "Paycheques at Salomon Brothers spiralled higher in spite of the willingness of others who would do the same job for less."

In other words, an apparently intelligent graduate from one of the major economics courses in the United States was able to assert, thanks to his understanding of the principles of economics, and in particular the law of supply and demand, that the reason he as an investment banker was paid a salary many times higher than that of his sister who taught children with learning disabilities was that fewer people were available to do his job, relative to demand, than was the case with his sister's. And this was despite overwhelming evidence on a daily basis that the empirical foundation for such an assertion was worthless.

Indeed, orthodox economics is quite unable to answer a simple question such as this, other than by resorting to definitions of supply, demand and price which degenerate into tautology. Transparently, many more people relative to the level of demand are willing to supply their labour to the financial markets than are willing to become teachers, yet the price of the former product (the salary) is many times that of the latter. Of course, the interchange of supply and demand can affect prices, but not always to the exclusion of other factors operating on price.

Of course, it may be unfair to castigate economics on the remarks of a single MBA graduate from Chicago. Yet the question he was asked, and answered so well in terms of economic orthodoxy, remains: Why are people operating in, say, financial markets paid far more than, say, schoolteachers or academic economists? There are answers to this question, but none of them involves the "fundamental" principle of supply and demand.

James Tobin, the American Nobel Prize winner in economics, has questioned very seriously whether it makes sense from the point of view of American society as a whole to divert so much of its young talent from the top universities into financial markets. This debate is not new. John Maynard Keynes considered the same question in the 1930s, and expressed the view that on the whole the rewards of those in the financial sector were justified. Many individuals attracted to these markets, Keynes argued, are of a domineering and even psychopathic nature. If their energies could not find an outlet in money making, they might turn instead to careers involving open and wanton cruelty. Far better to have them absorbed on Wall Street or in the City of London than in organised crime. [pp. 3-7]

The theoretical constructs introduced to economics over a century ago continue to pervade discussions of policy. They provide both a strong bias towards and an apparently strong rationale for policies which move towards the creation of a free, competitive market. For example, the political and social agendas of Ronald Reagan and Margaret Thatcher were powerfully motivated by the logic of free-market economics. Or, to be more precise, free-market economics was used to underpin the ideological preconceptions of these politicians. The deregulation of financial markets in the 1980 in

the Anglo-Saxon economies; the deregulation of and increased flexibility in labour markets, a topic which is presently the subject of a fierce debate among the political classes of Europe; the privatisation of state-owned industries; reductions in welfare programmes — all these themes flow from the logic of the theory of competitive equilibrium.

As we noted in the first few pages of this book, disagreements among economists attract considerable publicity. But almost all such disputes concern the behaviour of the economy at the aggregate, macro-level, rather than at the micro-level of individual behaviour. It is the micro-level which is described by the equilibrium model of marginal economics, and which is fundamental to the world view of orthodox economists, regardless of any differences which they might have about how macro-economic policy should be conducted.

By far the most publicised argument in macro-economics is that between Keynesian and monetarist economists, which has persisted ever since the appearance of Keynes's major work, *The General Theory of Employment, Interest and Money* (1936). Keynesians are rather more inclined to believe in market failure than monetarists, and so not only attach more importance to the role of government in trying to regulate fluctuations in the economy through changes in public expenditure and taxation, but believe that even after a period of years such changes can have an effect on economic activity and employment.

The experience of the 1930s, against which Keynes wrote, did raise serious doubts about the continued existence of market economies in the West, particularly in Europe. An unemployment rate in America of more than 20 per cent led to the New Deal, but in Germany such a rate led to Hitler and fascism, and to a deep sympathy among many Western Europeans for the Soviet system. Communist parties came close to power in free elections in both France and Italy.

Such unemployment rates also raised doubts about the validity of free-market economics as a description of reality. Theoretically, under certain assumptions, free markets had apparently been shown to be efficient in allocating all available resources. But in practice, in the market for labour in particular, gross inefficiency prevailed. The number of those seeking work outnumbered by many millions the number of jobs which were available. Supply was much greater than demand.

Despite these difficulties, raised by the actual experience of Western economies, the theory of competitive equilibrium continued to retain its grip on the subject of economics.

The most powerful reason for the continuing appeal of the theory is that, despite their problems, Western market economies are clearly the most successful form of economic organisation yet invented. There is increasing power in the environmental critique of economic development but, as we saw in Chapter 2, mixed economies have delivered enormous benefits to their citizens over the past two centuries.

The model of competitive general equilibrium is regarded as a theoretical, idealised form of the workings of such economies. It is this link, made between the transparent success of Western economies and the theoretical economic model, which sustains the intellectual dominance of the model.

It cannot be emphasised too strongly that, in practice, the competitive model is far removed from being a reasonable representation of Western economies in practice. By definition, any model necessarily abstracts from and simplifies reality. But the model of competitive equilibrium is a travesty of reality. The world does not consist, for example, of an enormous number of small firms, none of which has any degree of control over the market in which it is operating. Small firms may be fashionable at present, but it is the large multi-national companies such as Ford, BP and Sony which dominate the world economy. It is entirely illegitimate to make the link between the model and the observed success of the Western market economies.

The theory introduced by the marginal revolution was based upon a series of postulates about human behaviour and the workings of the economy. It was very much an experiment in pure thought, with little empirical rationalisation of the assumptions. Designed as a logical description of how rational individuals and companies ought to behave, the emphasis lies equally on the words ‘rational’ and ‘individual’. The individual is considered to be the key building block of the system, the behaviour of the economy as a whole being simply the summation of the behaviour of its component parts.

This attitude was articulated with unusual clarity by Ronald Reagan when he was governor of California. In the context of an environmental debate about redwood trees, he made the famous remark: “When you’ve seen one redwood, you’ve seen ‘em all.” The idea that there might be quite different qualities in a collection of redwoods which could not be captured by looking at a single specimen was dismissed out of hand. [pp. 47-49]

Over the years, many leading economists have, after all, entered actively into public policy debate, articulating their view of the world and setting out clear policy prescriptions. Keynes in the inter-war years and Milton Friedman in the 1970s and early 1980s have been perhaps the two most prominent examples.

This phenomenon should not be confused with the bombardment in recent years of television, radio and the press by economists employed by financial institutions. With very few exceptions, these outpourings are essentially part of the public-relations and advertising activities of the companies concerned. Indeed, on Wall Street a stipulation in the contracts of a number of economists is that they should secure a certain minimum amount of media coverage for their company. Despite the high salaries involved, employing economists is a cost-effective way for banks and stockbrokers to secure exposure in the media.

But the bulk of economics as a discipline is carried out within universities around the world, with, to paraphrase Schrödinger, small groups of the initiated musing to each

other. This lurking mass, despite overwhelming empirical evidence against the validity of its theories, dominates the subject, and even surfaces occasionally to see the light of day. It is this mass which forms the subject matter of the present chapter. Of necessity, we will at times need to use the 'virulently esoteric chat' which surrounds the core model of economics, but this should not detract from our intention, which is not merely to provide an exercise in ivory-tower criticism. Indeed, as we have seen, the model of competitive equilibrium, built on the premise of Rational Economic Man, currently exercises a great deal of influence on the conduct of practical economic policy in the real world.

The whole emphasis of economic policy in the West in the past ten to fifteen years has been to implement free-market 'solutions' to problems. Labour markets must be made 'flexible'. Industries in the public sector should be privatised. Financial markets should be freed of tiresome restrictions and deregulated, both within the domestic economy and in terms of relations with the rest of the world, so that, for example, controls on the movement of capital should be abolished.

The prime movers in the recent fashion for free markets were the right-wing administrations in Britain and America at the start of the 1980s. But many nominally centre–left governments have been unable to resist the pressures. France under Mitterrand, Spain under Gonzalez, Australia under Hawke and Keating and New Zealand under Lange are all examples of countries in which notionally social-democratic governments adopted most of the policy agenda of Margaret Thatcher and Ronald Reagan.

Following the election of Bill Clinton in the United States, there are signs that the previously irresistible drive towards free-market solutions is being checked, but as the twentieth century draws to a close the dominant tendency in economic policy is still governed by a system of analysis inspired by the engineers and scientists of the Victorian era.

The practical influence of the theoretical model of competitive equilibrium during the past decade or so has been enormous. Certainly, it has been far greater than it was for many years after the Second World War. The phrase 'rolling back the frontiers of the state', coined in the late 1970s in the early days of Mrs Thatcher's leadership of the British Conservative Party, inspired governments around the world during the 1980s, regardless of their political background. The Labour Party in New Zealand, for example, had a tradition of economic regulation and intervention which was almost unparalleled outside the Soviet bloc. Yet in government in the 1980s the party introduced a free-market reform programme that drew the admiration of a former adviser to Margaret Thatcher, who said it had moved more quickly and more brutally to liberalise the economy than she would have ever dared.

In the past decade or so, free-market policies have led to a number of conspicuous failures. Britain, for example, has been at the forefront in Europe of policies designed to deregulate labour markets, to make them correspond more closely to the flexible free-market ideal. A series of laws has been passed on trade union activity, for example, each

one restricting more and more the ability of trade unions to function. But British unemployment remains very high, at over 10 per cent of the labour force, or just under 3 million people. This compares to an average of under 0.5 million in the more regulated, corporatist policy regime of the 1950s and 1960s.

In the United States, deregulation of financial markets has produced many effects, one of which has been the Savings and Loan scandal. For many years, Savings and Loan companies (S and Ls) were the epitome of cautious, conservative Middle America. Small savers deposited their money in the local S and L, which in turn lent the money to people to buy houses. Government regulations controlled very strictly how S and Ls could use the money deposited with them — effectively, it could be put only into low-risk assets. The managers of S and Ls were known as 3-6-3s', because of their alleged habits of borrowing at 3 per cent, lending at 6 per cent, and being on the golf course by 3 o'clock every afternoon.

In September 1981, the world of the S and Ls changed dramatically. Congress allowed them to buy and sell the entire portfolio of their higher returns. But more than that, complicated new accounting procedures were introduced which allowed any losses made over the previous ten years to be offset against tax. In other words, the American government, courtesy of the taxpayer, effectively agreed to underwrite any losses which S and Ls made, at the same time allowing them to trade in risky assets, which they proceeded to do on a grand scale. On a single day in 1985, for example, Twin City Federal Bank of Minneapolis traded no less than $1.3 billion of mortgage bonds.

Not surprisingly, deregulation of this kind, supposedly liberating S and Ls from old-fashioned restrictions, encouraged a massive squandering of money by S and L executives, and attracted sophisticated operators in organised crime like bees round a honeypot. Wall Street, too, in an entirely legal but morally reprehensible way, exploited the naivety of the S and L management by charging enormous fees to carry out their dealings, making billions of dollars in profit at the ultimate expense of the American taxpayer.

Far from promoting economic efficiency, this particular aspect of free-market policy will end up costing the American taxpayer literally hundreds of billions of dollars.[pp. 67-70]

Staying with the issue of the environment, towards the end of Chapter 2 we came across an argument used by economists against the theses of the Limits to Growth studies in the 1970s. One such thesis was that the Earth was in danger of running out of key natural resources. Conservation measures were necessary to prevent this from happening.

Drawing on the price mechanism and the theorems of competitive equilibrium, the typical response of economists was to argue as follows: if a resource was beginning to run out, its supply relative to the demand for it would fall, and the price would rise. Demand would exceed supply. The price rise in turn would have two effects. First, there would be an incentive to search for further supplies of the resource, even in parts of the

world where its extraction would not be profitable at the previous, lower price. If these searches were successful, the resource would not become exhausted after all. Second, the higher price of the resource would encourage the development of substitutes. If oil, say, really were running out, there would be a big incentive to develop wind and wave power as a means of supplying energy.

These two factors are undoubtedly a feature of the real world. When the countries of OPEC combined to raise the price of oil by three or four times in 1973-4, subsequent years saw both an increase in interest in alternative energy sources and, even more important, further exploration for, and extraction of, oil from difficult climates, such as the bleak and hostile North Sea.

But some economists looked much more deeply into the problem, and in the 1970s produced a number of important papers which addressed the question of whether the price mechanism could always be relied upon to save the world from running out of exhaustible resources. In a word, the answer was no.

In 1979, Partha Dasgupta of the London School of Economics and Geoffrey Heal, now of Columbia University, brought out a 500-page book entitled *Economic Theory and Exhaustible Resources.* A key sub-heading in one of their chapters reads: 'The impossibility of fully informative price systems'. In other words, it is not possible to prove the existence of a price system which will reflect all the information necessary to prevent a resource from becoming exhausted. Indeed, Dasgupta and Heal go further, and conclude their chapter by stating: 'We have noted several reasons why the market [i.e. the price mechanism] is likely to provide incorrect incentives for exploration activity.' In other words, the market is likely to fail!

The key reason why Dasgupta and Heal, among others, arrived at this conclusion was that in their theoretical models they allowed the future to exist. This may seem a bizarre statement to make, but it is not. The model of competitive equilibrium which has been discussed so far is set in a timeless environment. People and companies all operate in a world in which there is no future and hence no uncertainty.

Once uncertainty is introduced into the theoretical framework, many of the results obtained from the standard model of competitive equilibrium no longer hold. This is a point of the greatest importance, to which we return later in the chapter.

It is worth noting at this stage that the consequences of introducing uncertainty into the model are devastating. To follow on from our discussion above of competitive equilibrium and Pareto optimality, for example, in 1982 David Newbery of Cambridge and Joseph Stiglitz of Princeton proved that in an uncertain world a competitive equilibrium is in general not a Pareto optimum. In other words, except under conditions which even in their theoretical model the authors describe as being 'extremely restrictive', a very powerful and attractive property of the standard model of competitive equilibrium is simply not true.

Yet it is this standard, static model of equilibrium and its results which is taught as the core model of economics to students all over the world. Many economists have doubts about its validity as a description of reality. These doubts are held in varying degrees, some of them arising from the difficulties caused for the model by empirical evidence, and some from an awareness of theoretical results such as the ones discussed above. But despite such doubts, generations of students who are trained in economics at first-degree level accept its conclusions as the received wisdom, and its precepts pervade discussions of economic policy.

Remarkably, despite all the problems associated with it, the theory of competitive equilibrium retains a strong grip on the intellectual sympathies of academic economists themselves. In 1989, Darrell Duffle of Stanford and Hugo Sonnenschein of the University of Pennsylvania wrote an extensive review article on the theory of competitive equilibrium for the prestigious *Journal of Economic Literature*. The article began with the sentence: 'The greatest achievements of economic theory concern the determination of value in competitive markets and the extent to which competitive markets lead to an efficient allocation of resources.' The authors went on to say: 'Today, the general equilibrium model is not the exclusive province of the high-tech theorist; rather, it is a basic part of the professional economists' tool bag, and one that is increasingly used [my emphasis].' These sentiments are shared widely in the economics profession.

The profession in fact resembles the revellers in Edgar Allan Poe's chilling story 'The Masque of the Red Death'. Everyone is having a splendid time, indulging 'joyfully in virulently esoteric chat'. But some, at least, are aware of the existence of a presence among them that will ultimately cause the party to end in tears.

Perhaps the most devastating criticisms of the model of competitive general equilibrium have come from mathematicians and economists working within the profession itself. Two such examples have been mentioned already, the work of Dasgupta and Heal and that of Newbery and Stiglitz.

Economists feel able to dismiss sociological criticisms of their model of rational behaviour because sociologists have little or no mathematics. Economists are able to dismiss the conspicuous failure of certain policies designed to move the economy closer to the competitive ideal by pointing to flaws in the design of any particular policy.

Economists are even able to dismiss the vast weight of empirical evidence against the validity of their model, drawn from economic history, by the simple device of closing their eyes and chanting the 'as if' mantra, which goes as follows: it may appear that successful firms owe their success to the exercise of market power. It may appear that once a firm achieves dominance, it is very hard for competitors to break it down. It may appear that the long-standing success and dominance, and the ways in which such qualities are achieved, of companies such as Ford and Procter and Gamble contradict the assumptions of the theory. But, nevertheless, it is 'as if competition in the sense of the competitive model, with its infinite number of firms, prevails. And very occasionally, as we saw at the end of the last chapter, a Microsoft does appear from nowhere to shake the

dominance of an IBM, giving comfort and succour to the ‘as if’ believers.

But economists who can happily dismiss all these criticisms find it much harder to dismiss the mathematical critiques made from within the profession itself. These technical criticisms strike at the very heart of the theoretical model. For they take the model on its very own terms and ruthlessly expose its inadequacies.

Severe theoretical problems for the model of competitive equilibrium have in fact been known to exist for many years. For the important example to be discussed now, the original result was established no less than sixty years ago.

The theory of competitive equilibrium, as we have seen, is very much a theory of the behaviour of the economy at the micro-level. Each agent in the economy, whether a consumer or a producer, has at least one equation which describes his or her behaviour. The behaviour of the economy as a whole, at the aggregate, macro-level, is built up from the individual equations at the micro-level.

Even in a small economy, there will be a large number of equations describing the behaviour of each individual in it, whether the individual is a person or a company.

Competitive equilibrium requires that there exists a set of prices for all goods and services in the economy which ensures that demand in every single market is equal to supply. In other words, the price of each product must be such that the amount which producers are willing to supply at that price is equal to the amount which is demanded by consumers. If such a set of prices exists, all markets can clear and the potential existence of a competitive equilibrium for the economy, at least in a static world with no uncertainty, is established.

John von Neumann was an outstanding polymath, who made path-breaking contributions to subjects such as the mathematical theory of games and computing. He was perhaps the most brilliant of all the Central Europeans who thrived on and so much enriched the intellectual life of America in the middle decades of this century. In 1932, he gave some of his attention to the economic model of competitive equilibrium, and presented a paper at a mathematics seminar held at Princeton. Von Neumann asked a simple question: what mathematical assumptions are necessary in order to prove that a set of prices ensuring that supply equals demand in every market exists at all?

The question had been considered by Walras himself in his seminal contribution to the theory of competitive equilibrium in the early 1870s. Walras, and those such as Marshall who subsequently developed the theory even further, had the insight to realise that it was an important issue to address. But the treatment of it before von Neumann was rather rudimentary, and in any event the interest for economists was not in the mathematical proof of the existence of a solution, but in the consequences of a solution actually existing. In other words, in the consequences for economic policy which could be deduced from an idealised situation of competitive equilibrium.

Although the question itself was simple, von Neumann realised that the proof required a level of mathematics well above the capabilities of all but a small number of the world's economists in the 1930s, and which even now is normally taught only to economists in specialist classes at post-graduate level.

The essence of the problem is that there is a large number both of goods and services and of people and companies even in a small economy, each with an equation describing their economic behaviour. The ability to prove that a solution does exist for these myriad equations, that a get of prices exists at which demand equals supply in every market, requires some very special assumptions.

The problem is complicated by the fact that there are restrictions on the values which these prices can take, since otherwise the solution does not make sense in terms of its economics. To take the most obvious example, prices cannot be less than zero. A negative price means that the seller receives a negative amount for his or her product, or in other words pays the buyer to take the product away. So solutions in which prices are less than zero, while they might form a valid mathematical solution to the equations, are not permitted.

Von Neumann's problem was not to find an actual solution to any particular set of equations, but to find out what assumptions were needed to guarantee the existence of a permissible set of prices — for example, with no prices less than zero — in order to ensure that supply equalled demand in every market in *any* set of equations used to describe a competitive economy.

An analogy from high-school algebra might illustrate the point. The quadratic equation $x^2 - 7x + 12 = 0$ has two solutions, $x = 3$ and $x = 4$. There are a number of ways of solving this particular equation.

But it has been proved that a formula exists which can be used to solve *any* quadratic equation of this kind. The appropriate values can be fed into the formula, and the solution emerges. Von Neumann's problem can be thought of as analagous to the problem, not of solving any particular equation, but of proving whether or not such a general formula exists. If it does, solutions to any equations of this type are known to exist.

Von Neumann was able to prove that assumptions could indeed be made which would guarantee the existence of an equilibrium set of prices for any set of equations describing the behaviour of a competitive economy. But it took more than a decade for the economic implications of his mathematical results to be appreciated.

Kenneth Arrow of Stanford University, subsequent winner of the Nobel Prize for economics and arguably the most fertile and productive economic theorist since the war, began work on the theory of competitive equilibrium in the early 1950s. It is really through his work that economists became aware of the stringency of the conditions that are required to guarantee the existence of competitive equilibrium.

The economic interpretation of the mathematical results can be stated essentially as follows, namely, that a sufficient range of goods and services should be produced to ensure there are very few gaps in the availability of markets in which consumers are able to participate. For the most part, this appears to be satisfied. But there is a very big gap in the provision of markets which concern *future* events. In financial markets and markets for many commodities, it is often possible to trade, not in the prices which obtain today, but in the prices which are expected to hold at particular dates in the future.

For example, it is possible for someone holding dollars to agree to exchange them for sterling, not today at the current exchange rate, but, say, in one month's time at a rate which is agreed today between the buyer and the seller. This latter rate will usually be different from today's rate, for currencies are expected to alter in value over time. Similarly, for many commodities, such as gold or copper or soyabean, markets exist in which contracts can be made to buy or sell fixed amounts of the commodity at specified dates in the future. Even more sophisticated markets exist, such as those which do not offer the direct ability to buy or sell in the future at a price fixed today, but the option to buy a contract which would allow one to choose whether or not to buy or sell in the future at a price fixed today.

Outside such markets, the ability to trade in this way is extremely limited. Insurance can be obtained against certain contingencies, whereby a fee is paid today which guarantees the receipt of a larger sum in the future if a specific event takes place, such as damage to a car or the death of a partner. But in general people are unable to trade in future markets for the simple reason that these markets do not exist. It is not possible to go to the local supermarket and agree to buy a specific basket of goods in eleven months' time, say, at a price which is fixed today. It is not possible to agree to sell a house in twenty-three years' time at a price which is fixed today.

These examples may seem slightly odd, but they illustrate the point about the general lack of markets in which trade in the future can be carried out today. For most dates in the future, for most goods and services which are bought today, markets do not exist which enable contracts to be struck today about buying and selling in the future.

Yet according to the assumptions needed in the theoretical economic model to guarantee the existence of a competitive equilibrium, such markets must exist in proliferation. In other words, even given all the other assumptions of the competitive model — such as a large or even infinite number of consumers and companies, with no single company being able to exercise any control whatsoever over the market price of its product, nor any trade union able to exercise any influence over the pay and conditions of its members — it is still not possible to prove that a set of prices will exist which will permit demand to equal supply in all markets, without making the further assumption that there is a very large number of futures markets, transparently more than the number which exists in reality.

It is research such as the above that creates the most difficulties for orthodox defenders of the model of competitive equilibrium. By accepting, for the purposes of analysis, all the

assumptions of the competitive model, and by refining them and making them more precise, it demonstrates the improbability of their existence in practice.

Economists are aware of this work, and some of the best minds in the profession have in recent years risen to the challenge, by constructing theoretical models which might be described as approximately competitive. In other words, models which examine how far one can deviate from the set of assumptions required to derive the model of competitive equilibrium, thus bringing it closer to the real world while still being able to retain most of its properties.

Much of such theory, particularly in the past decade, has focused on the problems caused either by firms having some degree of control over the price they can charge, or by workers having some control over wage levels through the influence of trade unions. Neither of these assumptions is permitted in the standard model of competitive equilibrium — they violate the basic mathematical assumptions which describe behaviour in the model. But even orthodox economists perceive that such influences may well exist in reality.

The concern of this recent theoretical work is to examine whether the existence of relatively minor degrees of control over prices enables a model to be generated which is similar to that of the pure competitive equilibrium construct. The research does not attempt to examine the consequences of a model in which large firms dominate markets, exercising power and influence through a broad range of strategies, such as pricing, advertising and promotions, research and development, and so on — in short a model which to many people seems a good description of reality — for it is recognised in economic theory that in such a world the propositions of competitive equilibrium certainly do not hold. Rather, the research is concerned with fairly small violations of the assumptions of the competitive model.

This literature is often motivated by a desire to save the equilibrium model from the challenge of empirical criticism. Joaquim Silvestre of the University of California, in a survey of such work in the *Journal of Economic Literature* in 1993, noted that ‘most economists view [competitive equilibrium] as an idealisation. They accept that some agents have at least a minor price-setting capability that generates, they believe, an approximate Walrasian outcome.’ But, as Silvestre shows, some of the more recent theoretical models have shown that even negligible violations of the assumption that no individual or group in the economy can exercise any influence over the prices at which any goods and services are bought and sold, lead to outcomes far removed from those of the standard model of competitive equilibrium.

The conclusions of this theoretical work are unsurprising. Almost forty years ago, an important contribution to the literature demonstrated that serious problems exist for the model of competitive equilibrium if any of its assumptions are breached. Richard Lipsey — the author, despite the implications of his paper, of a best-selling and highly lucrative textbook on economic theory — and Kelvin Lancaster, both based in London at the time, examined an important practical issue.

The authors were not dealing with the fundamental problem of whether a competitive equilibrium exists; they had a different concern. Supposing that, by some unspecified means, it was known that in the United States all the conditions required to satisfy the assumptions of the model of competitive equilibrium held in practice, except just two. For example, suppose that no firm could exercise any degree of control over its price, except, say, General Motors. And no trade union could influence the pay and conditions of its members, except, say, the Union of Automobile Workers. This actual example was not used in the Lipsey and Lancaster paper, whose language was mathematics, but it helps to illustrate their result.

If both the company and the union had their power taken away from them, all the conditions required for a competitive equilibrium to hold would be satisfied and, on the logic of the model, the whole economy would be better off. In such a situation, the guideline for economic policy would be clear: remove the power of both the firm and the union.

Lipsey and Lancaster effectively asked the question: what would happen if it were possible, for whatever reason, to take away the power of only one of these, leaving the other, whether the company or the union, to retain its power? Could it be shown theoretically that the economy would be better off than if both of them continued to hold their power? On the face of it, it seems logical that it should indeed be so. If a competitive equilibrium represents the most efficient allocation possible of the resources of an economy, a situation in which the UAW could influence wage levels but GM could not influence the price of cars ought by common sense to be more efficient than a situation in which both of them had their powers.

Unfortunately, common sense is not always a good guide to the truth. For Lipsey and Lancaster proved that such a statement is not necessarily true. In order to make an unequivocal statement, on the criterion of the equilibrium model itself, that an economy is better off if some of the violations of the assumptions required in the competitive model are removed, then *all* such violations need to be removed. If just one of many, or even just one of two, is removed, it is not possible to prejudge the outcome. The economy as a whole can theoretically be worse off if just one violation exists than it is when two such violations exist.

This is a result of great practical significance. For in reality, not just in America but in every Western country, there are many breaches of the conditions required by the theoretical model of competitive equilibrium. There is a presumption, which as we have seen has been the driving force of policy in many Western countries in the past decade or so, that each single move towards the ideal competitive economy will improve the performance of the actual economy. Lipsey and Lancaster showed that no such general presumption can be made. And, despite subsequent papers on this topic, their basic finding has not been disproved. Namely, that each proposal to increase the degree of competition in an economy must be treated on its merits. Maybe it is sensible, or maybe it is not. Each policy must be examined carefully and judged empirically. It cannot be

argued that increasing the degree of competition in an economy, when other obstacles to competition remain, will automatically improve the performance of that economy.

Mathematical economics has raised yet further difficulties for the construct of competitive equilibrium. Suppose, by some miracle, a competitive equilibrium does exist. There is a set of prices which if it were brought into being would ensure that all markets cleared. The question now becomes: how is this particular set of prices established?

Walras, over a century ago, realised this question posed potentially serious problems for his model. To overcome them, he assumed the existence of an auctioneer — or, rather, an Auctioneer, for this mythical creature has played an important role in theoretical economics ever since.

The role of the Auctioneer is to co-ordinate the exchange of information in the economy. A trial set of prices is issued by the Auctioneer to consumers and producers. They respond by providing information as to how much of each product they would buy or make if this set of prices existed. Except by a pure fluke, this initial trial set will not be the set which ensures that all markets clear.

The Auctioneer studies the responses of the agents in the economy, and issues another set of prices. People again respond by indicating how much they would buy or sell. The process continues until the set of prices which would clear all markets is arrived at by the Auctioneer. Producers and consumers are told that these are the prices which will exist. Only then is any actual buying and selling allowed to take place.

In practice, it might well be rather difficult for the Auctioneer to find the set of prices which would clear all markets. Indeed, there is no guarantee that it would be found at all. Recent theoretical work, which allows individual agents in the economy to search for themselves, always subject of course to the iron law of diminishing returns, faces exactly the same problem. The method of search we have described, in which a trial set is proposed and is then modified in the light of new information, is a familiar problem in applied mathematics. It has become well known in recent years as a method for finding practical solutions to systems of equations which cannot be solved directly.

In school algebra, a familiar problem is to find the value or values of the unknown variable, x, in order to satisfy an equation or equations described in the question. Although most readers will remember times when they despaired of ever being able to find the solution of a problem set for homework or in an exam, solutions do in fact exist to the sorts of equations used in problems for schoolchildren. Thinking back, for example, to the quadratic equation mentioned earlier in the chapter, we saw that there is a formula which can be used to solve any equation of this kind.

But there are sets of equations whose solutions, if they exist at all, cannot be found directly in these ways. An example is when there is a very large number of equations in the system, as is the case in the model of competitive equilibrium. In these circumstances, a variety of techniques is available, all based upon the principle used by the Auctioneer to

find the values of the set of prices which will clear all markets.

An initial set of values is chosen, and fed into the system. The results are examined, and are used to alter the initial set of values to create a new set which hopefully comes closer to the desired solution. This new set is then fed into the system, and the whole process is repeated again and again.

Advances in computer technology have greatly facilitated the practical development of such techniques, which obviously require an enormous amount of number crunching. These developments have increased substantially our practical knowledge of the problems encountered in trying to find solutions to systems involving large numbers of equations.

It appears to be the case that the Auctioneer can guarantee to find the set of prices which clears all markets, but only by making some highly restrictive assumptions about the nature of the equations in the system. An analogy might help to illustrate the problem.

Imagine that an explorer, or, more likely, a participant in a television game show, is confronted by an enormous field. He or she is allowed to start from anywhere in the field. We might imagine the intrepid player being deposited by helicopter. The field has flat parts, but it is pitted with many craters, some small and some large, in the manner of a battlefield from the First World War. The task is to discover the deepest crater.

The difficulties, apart from the size of the field, are twofold. First, the game is played in pitch blackness and the only information permitted to the participant is to know whether he or she is on the flat, descending into a crater, or climbing out of one. Second, certain craters are so deep and their sides so steep that, once at the bottom, the player cannot escape from them. As can readily be imagined, the very deepest crater might never be found.

But suppose that there were only one crater in the field, and that from every point on the edge of the field the ground sloped downwards to its bottom. The discovery of the deepest part would then be an easy exercise.

Searching for solutions to sets of equations involves a process analogous to this. The only slight(!) complication is that the field exists not just in two or three dimensions, but in many dimensions!

The precise lay-out of the field will depend upon the equations which describe the behaviour of companies and individuals in the system, but there clearly can be no guarantee that in practice the topography will be sufficiently well-behaved to allow the Auctioneer to succeed in his task. In fact, scholars such as Richard Day of the University of California have recently constructed plausible examples involving a mere handful of equations in which it is not just difficult, but impossible, for the Auctioneers ever to discover a set of prices which ensures that demand equals supply in all markets.

The realisation that there might be many craters so deep that, once having got into one of them, our imaginary player can never get out has been of great concern to economic theorists in the past decade or so. The implication of such a situation is that there is not just one but many possible solutions to the equations which describe a competitive economy. In other words, there is not just one equilibrium in the economy, but many equilibria. Many of the papers covered in the survey by Silvestre mentioned above address this problem.

Two problems in particular are raised for economic theory by the concept of multiple solutions. First, it appears to provide a rationale for government intervention in the economy after all. Even if the assumptions which are required for competitive equilibrium to exist all hold, a free-market economy is unable to co-ordinate the decision as to which of the many potential equilibrium situations will actually be called into existence.

Second, and even more important, the existence of multiple equilibria reduces considerably the generality of the policy implications which can be drawn from the competitive model. If there is a unique solution to the equations which describe a competitive economy, large changes can be analysed within this framework, since by definition the economy will always end up at the unique equilibrium position. But with many solutions, it is possible to make statements only about the consequences of small changes in the locality of any particular solution. Otherwise, the economy might not slide back into its original crater, but be shifted to a position in the field in which it goes into a different crater altogether. In this new solution, for example, the wages paid to different kinds of workers might be quite different relative to one another than they we're in the initial solution. In other words, large changes around any particular solution might lead to important and unforeseen changes in the overall nature of the new solution at which the system ends up, and which the free-market system itself is quite unable to determine.

But imagine now that a unique competitive equilibrium does exist, and that the Auctioneer is able to find it. We are already in a remarkable world, but what is in some ways even more remarkable is that no buying or selling is assumed to take place until the Auctioneer has found his Grail in the form of the set of prices which will clear all markets. No production is carried out, nor goods and services purchased, at prices which do not ensure that all markets clear.

But now suppose that, instead of simply informing the Auctioneer about the amounts they would buy and sell if the list of prices he announces existed, people were to buy and sell at prices which did not clear the market.

This is more than a mere supposition. It is an accurate description of what does happen in the real world. Even people who have the resources to assemble large amounts of information before buying and selling often trade at prices at which supply and demand are not equal. A good recent example of this is property companies in countries such as the United States, Japan and Britain. A vast over-supply of office properties exists in major cities, and even at rents which are set in desperation at close to zero there is

insufficient demand to ensure they are occupied.

This phenomenon, of trading at false prices, to use the technical economic term, has serious implications for the model of competitive general equilibrium.

Once such trading has taken place, there can be no guarantee that, even if an equilibrium exists, the economy will ever converge to it. In fact, it is likely to move in cycles around the equilibrium, from one set of prices to another, at none of which are demand and supply equal in every market.

The final concept to be discussed in this chapter arising from mathematical work on the theory of competitive equilibrium brings us back to points raised earlier about the incorporation both of the future and of uncertainty into the model.

Uncertainty is an integral part of life, impinging on a whole range of issues, both trivial and important. Will it rain tomorrow when the children are being taken on a seaside treat? Will I have a job this time next year? Everyone deals with similar questions on a daily basis. As a cynic once remarked about economic forecasting, it seems to be very hard to get it right, particularly when forecasting the future and not the past. The future is inherently uncertain.

Yet this obvious and fundamental property of human existence was not analysed in any rigorous way in the competitive equilibrium model until the early 1950s, when Kenneth Arrow turned his attention to it, introducing uncertainty, albeit in a specific and restrictive way. (To put these qualifications on Arrow's work is not to detract in any way from the power of his analytical contribution. Rather, it is yet another illustration of how the absurdity of the competitive equilibrium approach has in many ways been best exposed by apparently esoteric work by mathematical economists.)

The task in the standard, timeless model of competitive equilibrium is to discover, if it exists, the set of prices which will ensure that supply and demand are equal, and that all markets clear. But once the future exists, a set of prices must be found which will clear all markets today; another set must be found for tomorrow, yet another for the day after, and so on, before any trading takes place.

In Arrow's version of the model, individuals and companies are permitted to be uncertain in the specific sense that they do not know for certain what the overall environment will be at any point in the future. For example, in a simple agricultural society, the set of prices which will clear all markets next year will obviously be different depending upon whether the harvest is good or bad. The task of the Auctioneer is multiplied many fold if the theorems of competitive equilibrium are to continue to hold.

Arrow demonstrated that, in order for a competitive equilibrium to exist, each person must prepare a complete list of all future states of the environment which might obtain. And everyone must hold absolutely identical and correct beliefs regarding the prices which would exist in each potential state of the world at every point in the future. This is

a world which, transparently, bears no resemblance to reality.

Although the sheer intellectual power of Arrow's work captivated economists, the discrepancy between the world of theory and the world of reality, once the future was allowed to exist, did not escape attention. An important research task was to investigate whether the uncertain future could be introduced into the model of competitive equilibrium in a more realistic way.

Roy Radner, a distinguished American mathematical economist, was able to relax Arrow's assumptions in a brilliant paper in 1968. He proved the existence of competitive equilibrium, given all the usual assumptions needed in the single-period model, even if different people had different beliefs about the future state of the world.

This was in one sense a marked advance on Arrow's world, in which everyone had to have identical, correct beliefs. But there was a cost. For Radner also showed that, for his proof to be valid, everyone in the economy needs to have an infinite amount of computational capacity —not just access to a Cray super-computer, but literally an infinite amount of capacity.

All contracts in Radner's model are negotiated at the beginning of the history of the economy, and from then on all actions are determined by already chosen strategies. There is never any need for anyone to revise his or her behaviour, because the choice of strategy is predetermined from the outset, and contracts are negotiated for each market at each point in time in every possible state of the world before any actual trading takes place. In such a world, a competitive equilibrium might exist.

Radner's paper was rich in insights, for he explored the consequences of a world in which people had neither perfect foresight nor access to unlimited computational capacity. In other words, a world which begins to look something like everyday reality. (The stress in this last sentence is very much on the word 'begins', because all the other assumptions required in the competitive equilibrium model discussed earlier are retained.)

Radner's conclusion is stark. The model of competitive general equilibrium, in his words, 'is strained to the limit by the problem of choice of information. It breaks down completely in the face of limits on the ability of agents to compute optimal strategies.' In other words, once a realistic concept of uncertainty is introduced, the model ceases to be of value.

The research agenda of theoretical economics in recent years has contained an important item. Namely, to try to rescue the model of competitive equilibrium from the fundamental problems raised for it, not by mere sociologists, or by applied economists and economic historians who sully their hands with facts and evidence, but by members of the Imperial Guard itself, mathematical economic theorists. And the attempt has failed.

But to end the chapter on a positive note, perhaps the deepest insight in Radner's paper of twenty-five years ago pointed the way to a new analytical approach to micro-economics

which even now has only just begun to be exploited.

As is often the case with penetrating insights, this one seems obvious once stated. If individuals and companies have infinite computational capacity, the entire future of the economy can be solved in a predestined way at the beginning of time. If not, individuals have to make decisions in a world in which there are two kinds of uncertainty. First, uncertainty about the future environment, with which the competitive model can cope. But second, uncertainty about the behaviour of others or about the outcome of as yet unperformed computations.

This latter point introduces a fundamentally different concept. The behaviour of any individual or company depends upon uncertain expectations about the future behaviour of the whole economy. But the future behaviour of the system as a whole is made up of the aggregation of the behaviour of all the individuals in the system. In other words, we have an economic system in which individuals at the micro-level are learning their own collective macro-behaviour, which latter is in turn the result of micro-behaviour.

Such systems have a property which might by now be familiar, for it is a recurring theme in the book. The behaviour of such systems at the aggregate, macro-level cannot be deduced from simple extrapolation of the behaviour of a single individual. The whole is different from the sum of the parts. There is such a thing as society.

Two hundred years ago, Adam Smith intuitively believed this to be true. Sociologists have long taken this proposition for granted. At the opposite pole to orthodox economics, with its focus on the rational, purposeful behaviour of individuals, sociology has been informed by the view that it is social and group norms rather than self-interest that drive behaviour. The mutual antagonism between the two disciplines is not helpful, for economists, once they abandon the intellectual structure of the competitive equilibrium model, might have a great deal to learn from sociologists. In fact, it is a sociologist, the American James Coleman, who has perhaps come closest to an attempt to blend the two disciplines, in his major work *Foundations of Social Theory*, published in 1990.

Unlike most sociologists, Coleman postulates the existence of rational individuals, and tries to base the derivation of social norms on rational individual behaviour. But although he does not set out his model in formal mathematics, Coleman is in no doubt about the fundamental importance of interactions between individuals, of how the behaviour of one person can influence the behaviour of others. His most scathing comment is reserved for the economist's model of competitive equilibrium based on the entirely independent behaviour of individuals, describing it as a 'broadly perpetrated fiction'.

The significance of Coleman's work from our perspective is that, while it is based on individual rationality, it shows quite clearly, from yet another intellectual perspective, that the behaviour of systems at the aggregate, macro-level is often very different from the behaviour patterns of its individual component parts.

Sociologists believe this to be true. Environmentalists regard it as an essential part of

their analysis. And now support emerges for the proposition from that least expected of sources, mathematical economics.
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