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Sobei H. Oda
(Editor)

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Lecture Notes in Economics
and Mathematical Systems 590

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(Editor)

Developments on Experimental Economics

New Approaches to Solving Real-world Problems

With 64 Figures and 36 Tables

Springer

Professor Sobei Hidenori Oda
Faculty of Economics
Kyoto Sangyo University
Motoyama, Kamigamo, Kita-ku
Kyoto 603-8555
Japan
oda@cc.kyoto-su.ac.jp

Library of Congress Control Number: 2007927160

ISSN 0075-8442

ISBN 978-3-540-68659-0 Springer Berlin Heidelberg New York

Production: LE-TEX Jelonek, Schmidt & Vöckler GbR, Leipzig
Cover-design: WMX Design GmbH, Heidelberg

SPIN 11954422 88/3180YL - 5 4 3 2 1 0 Printed on acid-free paper

Preface

This volume presents papers and speeches given in *the Experimental Economics Week in Honour of Dr Vernon L. Smith* held in Okayama and Kyoto, 13-17 December 2004, which consisted of Dr Smith's public speech and *the International Conference on Experiments in Economic Sciences: New Approaches to Solving Real-world Problems*.

Despite having a short history, experiments are now considered indispensable in economics as in other fields of science and engineering. As Dr Smith's Nobel Prize (2002) shows, experimental economics has now established itself in modern economics. In such an environment, researchers are expected to develop the tradition with new ideas in new fields for solving various problems in the real world. The Experimental Economics Week, which was organised to explore new fields for experiments with new approaches, provided a unique opportunity for those who were engaged or interested in experiments in their fields to discuss experimental approaches from various standpoints.

Economic experiments broaden and deepen our understanding of human behaviour, the economy and their interdependence. Some experiments are designed to observe how people behave. Experimenters control subjects' economic environment to guess their strategies, which are not always apparent in the real world. The environment may be game-theoretic (a person's gain or loss is affected by other persons' actions) or non-game-theoretic. In either case what is checked is subjects' behaviour. Some experiments are done to see how market or other economic systems work. In such experiments, subjects are not checked by the game but check the game for the experimenter to see the performance or the dynamics of the system the game represents. Some experiments examine how individuals' behaviour affects and is affected by the whole system. In the conference of the Experimental Week, the keynote and invited speakers taught important lessons about what economic experiments can discover and how they can contribute to the real world, while researchers from various disciplines presented various experimental works and applications in parallel sessions. The reader will find the fruits of this week in the following pages.

Part One provides Dr Smith's public speech and his keynote speech for the conference. The reader will find his insight and vision about the history of economics and the future of experimental economics. Part Two contains papers by seven of the invited speakers of the conference. The reader will find new ideas of the leading researchers in the field of experimental economics. The remaining parts provide twenty-one papers selected from the presentations in the parallel sessions of the conference. For the sake of the reader's convenience, the papers are divided into four according to the topic of each paper: Non-game theoretic decision making, Game theoretic decision making, Performance of Systems, and Interdependence of System's performance and individual behaviour.

The papers cover a broad range: experimental economics, experimental management theory, experimental accounting, computational economics, social engineering, etc. I hope the reader will enjoy and use the ideas in the book to advance our understanding and improve the real world.

The Experimental Economics Week in Honour of Dr Vernon Smith was sponsored by Kyoto Sangyo University (KSU). The international conference of the Week, namely *International Conference of Experiments in Economic Sciences: New Approaches to Solving Real-world Problems (EES2004)*, was organised and sponsored by KSU and the Hayashibara Foundation in Okayama. It is also an activity of the Open Research Centre Project *Experimental Economics: A new method of teaching economics and the research on its impact on society (2001-2005)*. The sessions of experimental accountings are supported with the cooperation of Research Institute for Economics and Business Administration, Kobe University, while the sessions of co-creative decision making are supported with the cooperation of Research into Artifacts Center for Engineering, The University of Tokyo. I should like to thank The Ministry of Education, Culture, Sports, Science and Technology and the above-mentioned organisations. I should like to extend my thanks to the contributors of the papers, the participants of the conference, the audience of the public speech and those who worked for the conference with me as the member of the organising committee of EES 2004 : Prof. Fumihiko Goto, Prof. Katsuhiko Nagase, Prof. Akira Namatame, Prof. Kanji Ueda, Prof. Hidetoshi Yamaji and Prof. Yoshio Iida. I should also like to thank Mrs Barbara Fess, the editor of Springer Verlag, who has shown a great deal of patience in seeing this book through the press. Last, not at the least, I should like to thank my wife Hatsuko and the young researchers and graduate students who studied with me and now are engaged in the Open Research Centre Project *Experimental Economics: Who learns what from economic experiments? (2006-2008)*.

April, 2007 *Sobei H. Oda*

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List of Contributors

Vernon L. Smith
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Tatsuyoshi Saijo
Osaka University

James C. Cox
Georgia State University

Ido Erev
Technion -Israel Institute of Technology-

Daniel Friedman
University of California, Santa Cruz

Robin M. Hogarth
Universitat Pompeu Fabra

Shyam Sunder
Yale University

Amy Farmer
University of Arkansas

Balázs Adamcsel
Loránd Eötvös University

Cary Deck
University of Arkansas

Chairs Kaskiris
University of California, Berkeley

Christiane Schiwieren
Universitat Pompeu Fabra

Dao-Zhi Zeng
Kagawa University

Daan van Soest
University of Amsterdam

Eric O'N. Fisher
California Polytechnic State University, San Luis Obispo

Fei Song
Ryerson University

Gen Masumoto
Kyoto Sangyo University

Hiroki Nakayama
The University of Tokyo

Hiroyasu Yoneda
Kyoto Sangyo University

Jane Vyrastekova
Tilburg University

Jordi Brandts
Institut d'Anàlisi Econòmica

Juergen Huber
Universitaet Innsbruck

Kanji Ueda
The University of Tokyo

Kazuhito Ogawa
Hiroshima City University

Kouhei Iyori
Hiroshima Shudo University

László Gulyás
Loránd Eötvös University

Matthias Sutter
Universitaet Innsbruck

Metin Senbil
Hiroshima University

Michael Kirchler
Universitaet Innsbruck

Nariaki Nishino
The University of Tokyo

Nobutada Fujii
The University of Tokyo

Pravin Varaiya
University of California, Berkeley

Rahul Jain
University of California, Berkeley

Ram Rajagopal
University of California, Berkeley

Ryoko Wada
Keiai University

Ryuichi Kitamura
Kyoto University

Shunichiro Sasaki
Osaka University

Sobei H. Oda
Kyoto Sangyo University

Susumu Fujii
Kobe University

Takemi Fujikawa
University of Western Sydney

Tatsuhiko Kato
Meiji University

Tomomi Kito
The University of Tokyo

Toshiya Kaihara
Kobe University

Utteeyo Dasgupta
University of Arizona

Yasuyo Hamaguchi
Nagoya City University

Yoshio Iida
Kyoto Sangyo University

Part I

Vernon L. Smith's Speeches

Public Speech: "Markets, Capital Markets and Globalization"

Vernon L. Smith

George Mason University

I want to begin with a quotation from David Hume on trade. He was writing in the 18th century in Scotland. David Hume was part of what we call the Scottish Enlightenment, and the two most important figures in the Scottish Enlightenment were David Hume and Adam Smith. And this is David Hume on trade:

> Manufacturers gradually shift their places leaving those countries and provinces which they have already enriched and plying to others, whither they are allured by the cheapness of provisions and labor, till they have enriched these also and are again banished by the same causes.

My message today is an optimistic message about the future, about economic betterment and the development of world trade and world resources. It is about exchange and markets, without which people cannot engage in task and knowledge specialization. It is this specialization that is the secret of all wealth creation. There is no other source of sustainable human betterment. We all function simultaneously in more than one world of exchange. Those worlds overlap, as we live first in a world of personal exchange, trading favors and friendship and of building reputations based on trust and trustworthiness in small groups and families; and, then secondly we live in a world of impersonal exchange, where communication and cooperation gradually emerged in trade with strangers, through markets. In this talk I want to speak of two kinds of markets. First, markets for commodities and services. These are the foundation of wealth creation. And secondly, I want to speak of markets for capital, or stock markets. Capital and stock markets are far more volatile and more unpredictable than are the existing commodity and service markets, but their function is to anticipate the commodities and services of the future.

I will also discuss globalization which is really nothing more than a new word for an ancient process of migration and development that began a long time ago when our common ancestors first walked out of Africa.

Exchange has its origin in reciprocity and sharing norms in the family, the extended family and tribes. This personal exchange allowed task specialization in hunting and gathering that laid the basis for enhanced productivity and welfare, which in turn enabled early peoples to migrate all over the world. Globalization for us all began when our ancestors moved out of Africa over 50,000 years ago, settled the Iberian peninsula and Southern Europe, Asia, then Australia somewhere around 50-40,000 years ago. These people discovered America, probably about 13-12,000 years ago, although it might have been earlier. And then finally they settled the islands of New Zealand and Madagascar only 1,000 years ago. So, long before the square rigger sailing ship, our ancestors had settled every continent, except Antarctica, and all of the major islands.

Early peoples, before nation states, traded tools, weapons, and public goods like symbols, customs, crests and unmolested rights of access to trade routes and hunting grounds.

In the laboratory, we believe we see the ancient norm of reciprocity and trading favors as it emerges in two person games between anonymously matched subjects, many of whom use trust and trustworthiness to achieve cooperative outcomes that consciously maximize their joint benefits. They voluntarily avoid choosing outcomes that take for themselves without giving something in return to their matched counterpart.

But when the same subjects, who consciously cooperate for betterment in elementary two person interactions, come to the laboratory to trade in impersonal experimental markets, what do they do? They strive to maximize their own gain, and in this process maximize the joint benefits of the group but without intending to. However, these markets are supported by externally enforced property right rules that prevent individuals from taking without giving in return, and it's the community support for these property rights that enable trade and specialization to occur.

In established commodity and service markets producers incur recurrent, relatively predictable costs, and consumers experience corresponding recurrent flows of value from consumption. But costs and values are inherently private and all such information is dispersed, decentralized among individuals. Command and control economies have generally tended to fail because such information cannot be given to any one mind. But how do we know that the price discovery process in commodity markets yields efficient surplus-maximizing outcomes? Well, we have discovered in controlled laboratory experiments that these recurrent flow markets are incredibly efficient, and these findings have been replicated many hundreds of times by different researchers and laboratories, first all over the United States and then elsewhere in the world. Moreover, the subjects in these experiments are not aware of the group welfare maximizing ends that their actions produce. Each, in pursuing his personal gain, achieves group maximizing benefits that are not part of his deliberate intention.

So what have we learned about markets? What is the unseen function that they serve? First, commodities and service markets are the foundation of existing wealth creation. Each of us earns our income from no more than one or two sources. Yet think of all the hundreds of items that we use or consume throughout the day that are produced by others whom we do not know.

The hallmark of commodity and service markets is diversity: diversity in tastes, human skill and knowledge, natural resources, soil and climate, which in turn account for differences in values and costs that we use to define and motivate gains from exchange in the laboratory.

The power of diversity to be extended and to serve human betterment depends vitally on exchange, both personal exchange in our intimate groupings and impersonal exchange through markets.

Initially, diversity was possible and encouraged through sharing and reciprocity norms in the family, thus, in stateless hunter/gatherer societies, the women and children gathered fruits, nuts, tubers and grains; the men hunted; old men advised in the hunt, fashioned tools, weapons and helped in gathering.

At many times and many places in prehistory, exchange was extended to strangers through barter, and ultimately through the use of commodity money and then finally modern monetary systems. Indeed early humans set the stage for a vast expansion of wealth and wellbeing whenever a tribe discovered that it was better to trade with their neighboring tribes than to kill them. If you kill them, they can't produce something and trade it with you tomorrow, nor can you benefit from their unique skills, learning, art, culture and experience. Similarly, if you let them live but steal from them, they are much less willing to produce more for you tomorrow than if you trade with them today.

Diversity requires freedom, because it is freedom that allows each to be as different as he or she is able and desires to become. Markets in turn support tolerance of freedom. Chile was a country that had little political freedom but opened the economy to freer choice, and this eventually spread to political choice and helped to bring democracy.

Diversity without the freedom to exchange implies poverty: no human, however abundantly endowed with a single skill or a single resource, can prosper without trade. Robinson Crusoe owned an island, but he was poor.

We have need of others and of the diversity they bring to the table if we are to rise above bare subsistence. Through markets we depend on others, whom we do not know or recognize or understand. We know not how and in what ways others contribute to our welfare, and we contribute to theirs. Such are the long subtle chains of interdependence through markets connected by prices. The welfare of each of us depends vitally upon the knowledge and skills of others with whom we trade through markets. Diversity is made possible, productive and permissive of wealth creation through market institutions.

Without markets we would indeed be poor, miserable, brutish and ignorant; if some were less poor, it would be because of conquest, theft, taking without giving in return, which can be sustained only for as long as there are others to conquer. Markets require consensual enforcement of the rules of

social and economic exchange. No one said it better than David Hume over 250 years ago, when he said that there are just three laws of human nature: the right of possession, its transference by consent, and the performance of promises. These are the ultimate foundations of order, with or without formal law, that make possible markets and prosperity.

Notice that Hume's Laws of nature are derived from the ancient Judeo commandments: Thou shalt not steal; thou shalt not covet the possessions of thy neighbor; thou shalt not bear false witness. But these same commandments emerged in other religions the world over as they became norms for sustainable, stable societies. By sustainability, I mean the ability of a community to feed clothe and house itself without transfers from others.

The game of steal consumes wealth without encouraging its reproduction, while the game of trade sustains and grows abundance.

Coveting the possessions of others invites an involuntary state-enforced redistribution of the gains from specialization and trade, endangering incentives to produce tomorrow's harvest perhaps as surely as its theft.

To bear false witness is to undermine community, management credibility, investor trust and confidence, long-term profitability and the personal social exchanges that are most humanizing.

I want to turn next to the topic of stock markets. These markets are inherently far more uncertain than markets for commodities and services because stock markets must anticipate innovations, the new commodities and services of the future. At the time of new innovations, the extent of their subsequent economic success is inherently unpredictable.

In laboratory stock markets, even where fundamental value is well defined inexperienced subjects produce great price bubbles and crashes; if and when they reach a fundamental value, rational expectations, equilibrium, it is through experience. Consequently, the behavior of laboratory stock markets is much more erratic than the recurrent flow markets for goods that we study in the laboratory.

If changing knowledge and technologies are to yield new commodities and services, they require capital. Capital markets allow the users and suppliers of capital to be distinct and more specialized; the savers do not also have to be the entrepreneurs that can grow new wealth from capital investment, and both can gain by exchanging investment for a share of the return, each also bearing the risk of loss.

Stock market bubbles and crashes, such as the one that we experienced just a few years ago, at the end of the decade of the '90s, are not new. Why is this? Essentially, great stock market booms are fueled by new technologies.

For example, in the 19th century the steam engine allowed the steam ship to replace the square-rigger sailing vessel, the railroad to replace the mule team and the stagecoach. Railroad expansion in 19th century America outran the shipping needs of inter-regional trade.

Profitability turned to losses, bankruptcies and consolidations. But out of this 19th century expansion, long-term value was created and retained for the entire economy.

Then at the turn of the 20th century many new technologies emerged. Telephone, electricity, petroleum and automobiles sustained a wave of investment and development. There was over-expansion in response to high profitability followed by declining margins, losses, bankruptcy, consolidation, but long-run value was created and not lost to the economy. Bankruptcy allows the assets of failed managers, human and physical, to be reallocated to successful managers.

If you go back 100 years ago today and look at the early automobile industry which developed in the United States, there were literally hundreds of small manufacturing operations for automobiles.

A third of those small companies were experimenting with battery-powered automobiles. This is 100 years ago. Thomas Edison had invented the battery and he had invented a battery-operated automobile and other people were doing the same thing. All those experiments failed. They failed, for one thing, because the range of these automobiles was not very great, and also there was an inadequate availability of facilities for recharging them, and of course the batteries were very heavy.

Many other of these companies, in fact, most of the other companies at the beginning were based upon the steam engine. The steam engine was a natural thing for people to think of for an automobile because the steam engine had been so successful in the steam ship and locomotive. But there was one major problem: they took a long time to heat up and the creation of an automobile based upon that technology simply was unable to satisfy consumer demand and preferences.

The winner was a long shot: it was the internal combustion engine, but very few at that time anticipated that. Henry Ford was successful in creating an internal combustion engine and in producing a standardized automobile, the Model T. At the time of the First World War, Henry Ford had produced nearly half of all of the automobiles that had been produced and sold.

So my point is, out of this very large number of experiments, entrepreneurs risking their own capital, there were very, very few winners. And of course, the history of the automobile industry since then is marked by constant innovation and change, improvements in the internal combustion engine and all aspects of the motive system.

During the 1970s there was a movement in the United States to protect the automobile industry from Japanese imports. Very fortunately for America, that movement failed. The importation of quality automobiles from Japan helped to motivate and to force American automobile manufacturers to produce a better product, and the American consumer very much benefited from that process. And today we have the prospect that probably within a few years Toyota in Japan will exceed General Motors in the production of automobiles.

I grew up in Wichita, Kansas, and Wichita had 15 airplane manufacturers in 1929, most of them you've never heard of: Lark, Laird, Swift, Knoll, Travel Air. But there were two new company names in 1927: Cessna and Stearman. A decade later Stearman had become part of Boeing and the general aviation survivors were just two: Cessna and Beech. Clyde Cessna had been a farmer who tinkered with farm machinery and was a mechanical genius. Walter Beech got fascinated by the aircraft industry and became a test pilot. These two, Cessna, Beech, and Stearman through Boeing, made Wichita the national center of this new industry and then eventually became an international center for the manufacture of light planes.

The ball point pen today is an almost invisible but classic example of innovation and change. I remember about 1950, I think it was around 1948 or '49, when the first ball point pen came out. They initially sold for $10 back in those days; it was an enormously profitable new product, there was a big rush of entry, falling prices, losses, consolidations, many firms were squeezed out and went bankrupt, but the pen stays, yielding continuing long-term value of which we are not aware, except that we are all a little bit richer as a result. Today in the United States when we buy one of the more popular pens, a BIC pen, it costs 50 or 60 cents, we are unaware that that pen today is far superior to those $10 upstarts over a half century ago.

So picking winners and losers is inherently risky. More than 60% of manufacturing firms have left the industry in their first five years, this is even after they get fairly well established; 80% in their first ten years. Now the 1990s brought an unprecedented volume of new public offerings, and I'm sure that the history of that decade will record an unprecedented failure rate, but also, and much less visible, an unprecedented increase in long-term economic value for the economy. The recent bubble and crash was fueled by new electronic communication, computer, biological and pharmacological technologies. The diesel truck engine is an example of long-term value in the old economy created by companies, some of which are now stressed if not in bankruptcy. Each cylinder is computer controlled for minimizing fuel consumption and meeting tough new emissions standards under all operating conditions.

It is painful for those who risk investment in new technologies and lose, but the benefits captured by other industries, and by the learning and consolidations that leave value for the few winners, are retained as new wealth for the economy that benefits everyone. This is the substance of growth, betterment and the ultimate reduction of poverty. This is why almost everybody is wealthier than were their grandparents.

How can the individual pain be eliminated and the long-term value achieved with a policy fix that avoids the risk of doing more harm than good? We don't know. If you limit people's decisions to make risky investments in an attempt to keep them from harming themselves, how much will that reduce our capacity to achieve technological advancement? The hope of great gain by individuals fuels thousands of experiments in an environment of great uncer-

tainty as to which experiment or experiments will be successful. The failure of the many is part of the cost of sorting out the few that will succeed.

I want next to turn to globalization.

The first long-distance trade between Europe and the Near East allowed us to escape the static dead-end and poverty-ridden Middle Ages. This led to new explorations by stock companies and nation states.

This exploration was driven then by a new technology, and at that time it was the great square-rigger sailing ships.

As commerce spanned the old and new worlds, there was a worldwide exchange of plant and fruit products. The Italian gourmet had not a single tomato until the plant was imported from the new world; nor did the Irish have the potato until one of the thousands of varieties that had grown wild was imported from South America. The diversity of nature was the basis of much wealth creation through exchange. Instead of cutting edge research and development, we had exploration, transportation and transplantation.

So in the 19th century the seas were spanned by steamships, the Continents by the steam locomotive railroads.

Whole regions now began to specialize in different industrial and agricultural products depending upon their natural comparative advantages. The diversified subsistence farm reformed into the cattle ranch, the wheat, barley, corn and rice farms, the milk farm and the chicken farm.

And then, as I've indicated, the latest great thrust in globalization is driven by innovations in computing power, communications and higher-speed transportation. All three have served Internet exchange.

The retail store was once the place where buyers met producers through the intermediary of the merchant who risked the purchase of inventories of what he hoped people would want to buy, and the buyer risked the quality of the goods produced.

This very high-cost way of matching consumers with producers has been challenged by the Internet, where buyers and sellers are matched at practically near zero cost, and new institutions are being created for direct shipment, and for the quality assurance through competition in reputation formation, warranties, liberal return policies. This new dream world of potential profit led to over-expansion as investors threw investment funds at all the retail dotcoms, just as their ancestors a century earlier had thrown investment funds at the railroads.

Current globalization is bringing a new discipline to national governments. Budget and monetary excesses by national governments discourage foreign investment, while encouraging domestic nationals to seek foreign, more stable, investment opportunities.

I visited Mexico two years ago and I learned that monetary policy was aiming at a 3% rate of inflation, but they got 5.5% instead of 3. This is in effect a tax on domestic capital investment, and Mexican investors are motivated to take their capital to better-managed foreign countries.

South American countries can better serve their people by asking how they can learn from Chile to bite the bullet, stabilize currencies, control government spending, privatize government-owned industries, and reduce barriers to free trade.

In particular, there is the need, I think, emphasized by Hernando de Soto for institutional change enabling the owners of real estate and other assets to hold clear fungible titles. Only in this way can exchange value reflect use value and facilitate internal development.

In the United States, there is a very large and liquid market for real estate mortgages, that enables many entrepreneurs to use their homes and mortgages to finance some of their business activities. And when you go to many of the less developed countries of the world, you find that even though there is a lot of real estate investment and development, there is not any good market system for enabling those assets to generate equity investment capital for new businesses.

Not only capital but also people move to where there is opportunity, and this is the essence of creating new wealth and prosperity. In 1978 I first visited New Zealand. I flew into Wellington and I was picked up by a taxi cab at the airport. The driver was very friendly. You can learn a great deal about a country by talking to its taxi cab drivers. I asked him to tell me about his country. Oh, he says, it's a wonderful place. He says, I like living here. He says, of course we have extremely high taxes and I don't like that. He says, as a cab driver I pay half of my income in the form of taxes, but we get all of these free services, free medical and health, free prescriptions, free education, all the way from elementary school to as high as you want to go in universities. He said: my son is going to become a medical doctor; he has finished his medical degree; he has served his residency, and he's ready to start practice. I said, well, that's a wonderful story, I really am happy to hear that. Is he going to practice in Wellington? Oh no, you can't make any money here, he's going to Australia!

What's interesting about that story, it was in 1978, within the next three years New Zealand had a foreign exchange crisis, the country was bankrupt, and that created the movement in the 1980s that led to privatization in New Zealand of a lot of the government-owned industries. And for a while New Zealand was able to reverse this brain drain that it was suffering at that time. Now, what I find particularly interesting about the brain drain is the fact that it is now being reversed in many places in the world. In India, in China, in Ireland, young people, who earlier left to seek opportunities and education elsewhere, many of those people are returning because their home countries are starting to provide better opportunities for those young people.

In conclusion, let me say that commodity and service markets are the foundation of existing wealth creation. The fact that stock markets serve by supplying capital for new consumer products explains why they are inherently uncertain, unpredictable and volatile, tending to bubble and crash. The problem always with new technology is how to manage it to produce products that

satisfy consumer preferences, and the costs incurred can be sustained by the willingness of consumers to buy the product. Stock markets are far more uncertain than markets for commodities and services because they must anticipate innovations, the new commodities and services of the future. Globalization is not new. It's a modern word describing an ancient human movement, a word for humankind's search for betterment, and the worldwide expansion of resource specialization, and specialization is determined by the extent of market development.

I believe globalization is a good word, a peaceful word. In the wise pronouncement of the great French economist Bastiat: If goods don't cross borders, soldiers will.

QUESTION 1: People want to grow their savings, and companies want to reduce their debt. The government tried to reduce the budget deficit, and Prime Minister Hashimoto raised taxes, which led to Japan's Great Stagnation in 1997. Each individual did their best to achieve their own profit, but the overall economy failed. The overall economy did not gain the best result. What do you think about Japan's economic situation?

SMITH: Well, of course I don't like to get involved in the politics of foreign countries, but I do believe that there is a movement, as I understand it, toward privatization of some of your industries, as I understand, the post, which is also a very large savings bank, and that's being debated in your country.

I don't follow the macroeconomic policies in Japan. I have a problem being entirely happy with the policies followed by my own government in the United States. We have a very large deficit, a growth in deficit in the last two or three years which I think is going to impede our own growth. The tax cut enabled us to avoid having a general recession following the stock market crash, but I think a very worrisome policy in the United States is the current account deficit.

You know, Japan has been in the past a model of economic growth and development for the world, and I think it's important for them to find the kinds of public policies that can enable Japan to return to that model level of growth and development. Anyway, I wish you best of luck with your political parties.

QUESTION 2: Experiments in the world of physics are trying to test what is happening through tests and trying to verify research and theory, and if the test results are not favorable you would propose new theories. But in economics experiments, do you also have similar experience that through the experiments you've found that certain results would not be indeed as well suited to a certain theory so you would have to change the theory or the

assumption? Did you also find similar experiences in your own experimental economics world as well?

SMITH: Very similar, and I want to talk about two examples. The first example is the discoveries that I began. The first experiments I did, beginning in January 1956, were concerned with the performance of markets in which information as to willingness to pay and willingness to accept on the part of buyers and sellers was dispersed among all of the participants, and also private, each individual knew only his own circumstances. It turned out that that was sufficient to give you convergence to competitive efficient equilibrium.

Now that sounds like a great victory for equilibrium theory in economics, except that that theory required complete information on the part of the participants. In other words, the equilibrium theory, which was able to predict what individuals achieved in the market, failed to establish or articulate the conditions, the information conditions that would enable it to come about.

What was missing was an adequate theory of the dynamic process whereby individuals go from their dispersed private information, the exchange of information through a bid-ask process in the market and then converge to a competitive equilibrium. We observed that, but we did not have a good dynamic theory of it, and we still don't. Fifty years later I'm still waiting for the theorists to come up with a better way of explaining that result. It truly was remarkable though that the conditions of supply and demand, which no one knew about in the market, and you have subjects in the experiment that know no economics, they have no sophistication, they do not have complete information, and yet through repeat interaction over time, each person learning to correct his early mistakes, converges to an equilibrium that none of the people in the experiment knows about.

Now that was a rather remarkable thing. And of course my first experience was that economists didn't believe it. And then people began to get interested in doing experiments, and they found that what I had discovered was a true representation of how those kinds of repeat interaction markets work.

So there was a case in which the static theory did better than it had a right to do. It didn't deserve to do that well because the theory didn't really account for the process that we observed among individuals in the experiment.

The other example was what we've discovered in connection with two-person interactions where people are anonymously paired; you don't know who you're paired with, and you and this anonymous counterpart are going to participate, say, let me give you an example of a simple two-move, two-stage game. We call this a trust game, not when we describe it to the subjects, but when we describe it in an article we call it a trust game. Suppose I move first and I'm matched with you. All right, I can do one of two things: I can choose to stop the interaction and I get $10 and you get $10, I can choose to opt out, to defect so to speak, and we each get $10; or I can pass to you. If I pass to you, the $20 becomes $40, and you have two alternatives: you can give me $15 and take $25, or you can take all the money, the $40.

Game theory predicts that I shouldn't pass to you because I can see that if I do it's in your interest to take all the money and I'll be left with nothing. Therefore, the equilibrium of that game is for me to opt out and we each get $10. Or if you do this experiment, we've done it with undergraduates, we've done it with teachers, we've done it with chiefs of staff in the U.S. congress and senate, democrats and republicans, and half of the people in the first mover position do not opt out, they pass to the other person. Seventy-five percent of the second movers give $15 to the first mover and take $25; they don't take all the money. Now this is clearly a violation of the kind of standard game theoretic economic way of modeling.

What's wrong? Well, you see game theory assumes that the participants will each act in a very narrow sense of the self interest. Given a choice between two piles of money they will always take the larger pile regardless of the circumstances. Now think about the circumstances in this simple experiment. If I pass to you, that means we both can be made better off. I have incurred the risk that you will take all the money. I do this obviously in the hope that you will give me $15 and take $25 for yourself. Most people, in fact typically about three-quarters of the second movers, appreciate that they should reciprocate my offer to cooperate.

Now most of the subjects that come into these experiments come from a world in which they are traditionally exchanging favors with their friends and associates. There is a phrase that is universal across most of the languages of the world and the phrase is, "I owe you one." Whenever somebody does something for you without even thinking, often people will say, "Thank you, I owe you one." So people all over the world are social exchangers engaged in reciprocal acts of goodness. When an offer to cooperate is denied, we often then use not positive reciprocity but negative reciprocity, we punish that act. And so it's very common for people to engage in punishment acts when people don't return the favor or they decide choose other people for their friends rather than associate with those people.

So my point here is that this laboratory research shows that people in these experiments have a more sophisticated notion of the self interest. It's not that they're not self-interested, but they recognize in simple two-person interactions that each can be made better off by reciprocating acts of goodness. Now of course game theory does predict that when you repeat these games, then you will get this reciprocity and people tending to cooperate. What game theory was unable to anticipate is that the norms of reciprocity are so strong in many societies that people will do it in a single play of the game.

So in experimental economics we have cases in which the theory is not falsified by the results, but even in the case of markets where the equilibrium theory is not falsified, the theory is simply not adequate to explain the dynamics, and in fact economics is still, I think today, very weak in terms of having good ways of describing the process whereby people begin from a very low state of information, exchange information and start to produce outcomes that are not only better but after a while they're optimal. And you can show

that they're optimal. And you can also show that no one in the experiment is aware of that. So all of these things can be demonstrated.

So I think there's many differences between economics and physics, but so far as the experimental method is concerned I think there is great similarity.

Also in physics, whenever there is an outcome that is disconfirming of a theory, people ask two questions: is the theory wrong or is there something wrong with the experiment? The same thing is true in economics, and in fact, much of the interaction at professional conferences in experimental economics involves questions of whether it's the theory that's false or whether there's something wrong with the experiment. And of course there's famous experiments in physics where in fact there was something wrong with the experiment.

A very distinguished experimental physicist by the name of Kaufman, in 1905 did an experiment that disconfirmed Einstein's theory of relativity. Ultimately, it was established that there were problems with Dr. Kaufman's experiment, and those problems were solved and the theory ended up being confirmed.

I gave a long answer to your question because the question is at the heart of much of what we do in experimental economics, and of course this university now has a laboratory in experimental economics and is well along in the process of developing the skills and methods that are used to falsify or confirm economic models.

QUESTION 3: In your presentation you talked about commodity markets and stock markets. You said that basically if the market is fully functioning, the wealth of the society will be maximized. I think that was the main point of your talk. What about the labor market? What would you say about the labor market? Here in Japan much labor has been outsourced to China and other East Asian countries, and this has led to unemployment of the Japanese. So as a result of the globalization of the labor market, many Japanese have been deprived of wealth. Do you have any comment about the labor market?

SMITH: Yes. There of course are some features, special features of labor markets that make them different from commodity markets. For one thing, there is much more of a reciprocity relationship between the worker and the employer. It's impossible frequently for the employer to monitor every aspect of the laborers' actions and therefore it's important to have a trust relationship there, and I think good firms do tend to develop that relationship. In fact, I talked about Henry Ford and the automobile industry. Henry Ford innovated what was called the five dollar day at a time when the most wages were around $2.80 a day. And he did that because he was trying to get the best workers to come and work for him and to create a favorable environment for that.

Now outsourcing is politically controversial everywhere, and it was very controversial in our latest presidential campaign between democrats and the

republicans. Outsourcing though I think is an excellent example of something that firms have to be allowed to do, and the reason is very simple. Suppose that you prevent Japanese firms from outsourcing where they can get the commodities produced at a lower cost. The competitors of Japanese companies elsewhere in the world can nevertheless outsource, and when they outsource, the Japanese firms, if they're prevented from doing it, run the risk that they will not be able to compete in world markets, they may eventually go bankrupt, and then you lose both the firms, the companies and the jobs.

Politically, there's always a constituency tending to protect yesterday's jobs; there's no political constituency for tomorrow's jobs. When firms outsource and save money it enables them to do two things: one is to lower prices and compete more effectively; the other is to invest in new technologies and better ways of producing new products. And you cannot get the new unless you allow the savings from the old.

You know, in Great Britain when the first textile machinery was invented it was thought that the labor market was going to be very severely impacted, as indeed it was. The Luddites wanted to destroy all the machinery. What's interesting though about the innovations in the textile industry is that that industry was able to expand, produce at much lower cost, and actually make possible an expansion of employment generally in the economies where those innovations were allowed to go forward. In fact, if you look at the history of innovations, there's always new jobs being produced and the employment levels have increased.

The problem I think in economic policy is to help workers adapt and acquire new skills and go into producing new products, and to do that so as to not prevent firms from outsourcing and obtaining the savings which not only that firm benefits from, but all of their customers and everybody they deal with. You know, in the United States, when I was finishing graduate school in Massachusetts, this was 1955, I had been there for three years, New England was still an important center for textile manufacturers. All of that textile industry that started in New York and New England was moving out of the region and into the South. It moved into the South because wages were lower. That movement helped to bring about a replacement of those industries in New England and New York by the higher tech, new innovations that were coming in. The lower wages in the South gradually were bid up. Today the wages are no longer much lower in the south, the textile industry is no longer in the South; it has moved to China and Taiwan and India and places like that. It has moved overseas, and that's exactly the reason why I started with a quotation from David Hume about manufacturers continually moving to where there is lower cost. And of course when they move to lower cost, they tend to raise those wages, and all of that is part of the process of human betterment, increasing output, reducing poverty, and the problem is to find ways to let that happen but allow the adaptation and adjustment to take place in the labor market.

That's what I think your policy should be focused on; how to help people in those industries move into new industries, but don't stop it from happening because that will make you still worse off.

Keynote Speech: "Foundations of Experimental Economics, Economic Design and Applications"

Vernon L. Smith

George Mason University

I want to begin with a couple of quotations. And in fact, here and there in the paper I will be using quotations from David Hume, Adam Smith or Hayek. This is not because I started as a classical economics scholar. It's also not because I started with an interest in Friedrich Hayek, an Austrian economist. The special value of their contributions is what I discovered after having a long career in experimental economics. And in fact, without my experience as an experimentalist I don't think there's any way that I could have been able to appreciate the full significance of these quotations that I'm going to use. I now see them as enormously insightful in terms of what we have learned from experimental economics. What astonishes me is that Hayek and some of these 18th century scholars could have gotten to this level of understanding without doing experiments. I could not have done that.

The first quotation is one of my favorites from David Hume:

> When we leave our closet, and engage in the common affairs of life, reason's conclusions seem to vanish, like the phantoms of the night on the appearance of the morning; and 'tis difficult for us to retain even that conviction, which we had attained with difficulty.

Now current research in neuroscience tells you how brilliant that quotation is because research in neuroscience tells us that we are of two minds, or what I prefer is to distinguish between the mind and the brain, the mind being the conscious self-aware thinking and reasoning we do which is a very, very small part of the brain's activities; the brain is typically on automatic control and this is what enables us to do most of the things we do without having to call upon the intentional and analytical resources of the mind. This distinction comes up over and over again in experimental economics, and we have become more aware of that dichotomy I think as the tools of neuroscience are used to better understand decision making of the kind experimentalists have been involved in over the last 40 or 50 years.

The next quotation is from Hayek, and anyone, which is probably most of the people in this room, who has conducted an experimental economics