Graciela Chichilnisky

Market Innovation and the Global Environment

The traditional economic assumption that environmental concerns run counter to productivity and growth has come under fire. Recent evidence clearly points in a new direction. To date, markets have evolved some of the most innovative and useful solutions for global environmental problems. These developments now lend credence to the view that countries with the highest environmental standards will concomitantly attain the highest competitive advantage. Chichilnisky argues that market innovation can serve as a powerful tool of environmental policy.

Markets are often considered enemies of the environment. A traditional view is that environmental issues are grounded on market externalities because, in cases such as smoking or CO_2 emissions, one individual's consumption is irrevocably linked to that of others. This leads to ill-defined private choices and to the failure of market efficiency. Markets can therefore induce overconsumption of environmental resources, such as clean air. Reciprocally, environmental concerns are often blamed for undermining market performance. Environmental regulation can lead to undue costs and prevent the unfettered behavior needed for achieving market efficiency.

Yet recent evidence points in the opposite direction. Markets have evolved some of the most innovative and useful solutions for global environmental problems. This includes new and profitable products such as catalytic converters, industrial scrubbers and waste management technologies, as well as new financial instruments such as tradeable emission permits, profit-sharing biodiversity ventures, and debt-for-nature swaps. One observes a positive groundswell of interest in the environment arising from all levels of the business community.

Graciela Chichilnisky, an Argentinian citizen and U.S. resident, is currently Professor of Economics at Columbia University's School of International Affairs. In addition to her post at Columbia, Dr. Chichilnisky is a Director of Science International, an international financial consultant, and has served as an adviser to various transnational corporations, international financial companies and U.S. agencies, including the United Nations and the World Bank.

Global Environment and Economics

The global environment offers the most interesting examples of, and also the greatest challenge to, conventional views. Rio de Janeiro's global conference in June 1992 confirmed that global environmental issues are with us to stay. They range from a concern for the world's remaining rain forests to industrial wastes and new technologies. These issues focus on economic variables such as trade and growth, and on North-South issues linking industrial and developing countries. These issues are at the core of the world's concerns for equity and development. The world's remaining rain forests are mostly in the South, which also produces and exports most of the minerals and scarce resources such as oil, copper, coal and wood. These resources are in turn mostly consumed by an insatiable North. The United States alone accounts for the consumption of about 30% of the world's oil production, and burning fossil fuels themselves account for most of the CO_2 that humans force into the atmosphere of the planet. CO_2 is the most infamous of the "greenhouse" gases, accounting for patterns of global climate change that are possibly irreversible. The global warming issue is thus inextricably linked to a pattern of North-South trade.[1]

A major puzzle that arises is that, despite all intuition to the contrary, economic growth does not depend on, and indeed is not related to, the availability of abundant or inexpensive resources. I will use resources to illustrate how our economic common sense may fail, and to explain how under certain conditions global markets could be counted among the world's main green advocates.

Abundant and inexpensive natural resources have been viewed as the foundation of economic growth and of the wealth of nations. This emerges from a linear view of production, where more inputs lead always to more output, and where less inexpensive inputs lead to increased production. In this view, inexpensive labor and indeed poverty constitute a comparative advantage. So do inexpensive coal and oil. So deeply ingrained is this view that the U.S. citizen, who pays for gasoline about 30% of what a Japanese or European consumer pays, worries that an increase in oil prices will lead to lower economic growth. The 1991 Gulf War and other extreme measures have been justified in terms of this presumed economic relation. It must be pointed out that the United States has the second largest oil deposits in the world, so that it not only consumes very inexpensive oil, but also has very abundant supplies as well.

Japan and Germany, two of the most productive and fastest growing countries in the world, are clear counterexamples to this view. Japan has practically no resources, and had none through the period of amazing economic performance that led it to its current leading position in the world economy. The Japanese car industry took the window of opportunity offered to it by the U.S. car industry's refusal to adjust to OPEC-induced high oil prices in the mid-1970s. The U.S. car industry was formerly dominant in the world, and a cornerstone of American industrial production and employment. During the 1970s it failed to provide its consumers with fuel-efficient vehicles. Benefiting from the Japanese experience with scarce and expensive resources, indeed building on it, and on the firm belief that scarce and expensive resources offer a market opportunity, the Japanese car industry took over the U.S. position. The only country that appears to beat Japan at this game is Germany, a country that also has no oil, that pays high gasoline prices and that is alone in continuously showing a trade surplus with Japan in the car sector.[2]

Exporting oil is also recommended to developing countries by the international organizations as a panacea to the their capital needs, and as a short cut to economic growth. Yet the data shows that, quite to the contrary, during the period of high oil prices (mid-1970s to mid-1980s) middle income oil exporting countries grew less and accumulated more debt than their oil importing counterparts. Inexpensive oil is not a reliable source of growth, nor are oil exports a reliable source of income or growth.[3]

Germany also offers a good counterexample to the view that international competitiveness is built on inexpensive labor. If Latin America and Africa do not suffice to show that inexpensive labor or poverty is not a competitive advantage, then Germany's extraordinary performance in international markets can be used to exemplify the value of highly productive and well-paid labor. Until now, Germany has had one of the highest paid and most productive labor forces in the world. Inexpensive resources, including labor and natural resources, do not guarantee international competitiveness. They do not provide a good foundation for economic growth.

This example forces us to reconsider some of the most commonly held views of the environment and the economy. Preserving the environment need not harm economic growth; indeed countries without resources that pay highly and value environmental resources have the highest growth records. There is an opposite and valid view contending that countries with the highest environmental standards will have the highest competitive edge in the world economy.[4]

The positive link perceived between abundant and inexpensive resources and economic growth derives from a misunderstanding of markets. Markets are far more complex and far less linear than we often understand them to be. It is because of the price mechanism that we internalize the value of scarce resources, and it is because of market prices that we can explain why the more we value the Earth's resources, the more we will pay for them in market prices, and the more productive we shall be.

Market Innovation: Examples

Perhaps the most innovative market approaches to environmental issues are exemplified by the newly introduced financial instruments. Financial instruments help to achieve optimal allocation of risk by redistributing wealth across time and across states of nature or of the economy. They are therefore best suited to deal with environmental risks that typically extend across time and states.

One instrument is *tradeable permits* for gas emissions, which will be traded shortly in the Chicago markets. These are financial instruments that control emissions by selling the rights to emit a certain quantity of gas, with the total quantity traded adding up to an environmentally safe level. Buying a permit entitles the holder to a given level of emission, and all holders together cannot exceed the total amount that is deemed to be environmentally safe. The issue of enforcement is left wide open, but the idea is simple and appealing, linking trading and market prices to industrial needs. Thus prices are permitted to fluctuate freely and resources are allocated in an optimal fashion.

Debt-for-nature swaps have a somewhat different flavor. Here debtor countries can "buy" back part of their debt in exchange for the right to use their own environmental resources. A typical case involves a deal to limit the use of rain forests as an economic resource for the production of wood, and to restrict deforestation to grow cash crops. The industrial countries buying into these deals obtain the preservation of "sinks" for carbon emissions or of biodiversity preserves. The word "sinks" is used to denote an area that absorbs CO_2, such as forests or other biomass. Industrial countries need CO_2 sinks to compensate for their overuse of gas emissions since, for example, CO_2 emissions from fossil fuels by the industrial countries are several times those of the developing countries, both currently and historically. Industrial countries need the biodiversity preserves of the South to compensate for their historical destruction of their own forests and biodiversity in their process of industrialization.[5]

The most innovative deals so far involve profit-sharing – or equity – agreements for preserving biodiversity. These deals are best for the purposes of sharing environmental risk such as the disappearance of species. Several examples have emerged in the last few years, one of the most prominent being IN BIO, a deal between Merck & Co. and the government of Costa Rica. IN BIO was designed by Professor T. Eisner, a scientist at Cornell University. Under the terms of their agreement, Costa Rica set aside 25% of rain forest land as a biodiversity reservoir to be used by Merck & Co. – the largest pharmaceutical company in the world – in exchange for about $1 million and a profit-sharing agreement on drugs developed and marketed by Merck on the basis of Costa Rica's biodiversity samples. Merck uses a random sampling R&D method on animals to discover useful genetic codes. Costa Rica's biodiversity is similar to a genetic library and the deal is analogous to one on intellectual property rights of, for example, software. Biodiversity was the source of many valuable drugs such as aspirin, curare and several oncogens such as the rosy periwinkle used to treat children's leukemia.

Another interesting example is provided by agreements reached by Shaman Inc. in Brazil and Argentina. Shaman means "medicine person." Shaman Inc. is a small California pharmaceutical company that is patenting a herpes medicine discovered using specific knowledge acquired from local medicine people. The deals of Shaman Inc. also share profits, but not with governments. Rather, they will share profits with the population of the localities from which the medicine people and their knowledge proceed. The economic incentives for preservation are therefore more accurate.

Several issues emerge in this context. In the case of tradeable permits, the foremost problem is allocation of initial property rights in the permits, namely the problem of their initial ownership. Industrial nations prefer land-based allocations, while developing nations prefer GDP or land-based allocations, for obvious reasons in both cases. Leaving aside the important issue of allocation, the next item is to decide among different risk and profit-sharing methods. Two main financial instruments are *debt* (bonds, for example), an instrument that pays a fixed return or interest, and *equity*, an instrument that shares the value of the project among the owners, whatever this value may be. The latter is better in terms of risk allocation, and it is closer to the nature of profit-sharing projects such as those of Merck and Shaman. There are also mixed instruments such as, for example, warrants, which are essentially debt with an option to convert into equity at a given price and within a given time frame.

One of the most difficult problems arises in cases where the actual value of the resource is not known and where the individuals concerned are aware that their own prefer-

ences for a resource (such as biodiversity) may vary over time as their knowledge develops. In this case one considers option values.[6] The instruments that are most appropriate here are the equivalent of options sold in foreign exchange markets, and for similar hedging purposes. Mutual insurance and securities to hedge against collective risk are also valuable to attain efficient allocations in the case of unknown risks.[7]

The Economics of Market Innovation

It is natural to ask how the market works successfully in these examples, and when does it not.

The main theorem of welfare economics, which assures the efficiency of allocations in competitive markets, fails when there are consumption externalities. The theorem fails because consumption is not purely private in such cases.

This failure arises because consumption by one individual is not a "private good," since it forces consumption on others. Passive smoking is a typical example.

Externalities prevent efficient market solutions because in calculating how much to consume at market prices, individuals fail to consider the consumption that they force on others, i.e., the "external effects." This is also called a "free rider" problem. Fisheries offer another good example. Each person may compute quite accurately the marginal returns of his/her fishing time and equate the market price with his/her marginal productivity, but nevertheless neglect to include in the computation the fact that the more he/she fishes, the less fish become available to others. Thus the productivity of fishing time is overestimated on the whole, and there is overconsumption of the resource. The fish population may therefore disappear. This is the well-known problem of the commons, which translates to global commons in the cases of the atmosphere or main bodies of water. It explains why there is a market failure when there are externalities in consumption.

But market innovation is not included in the main theorem of welfare economics. The theorem refers to the inefficiency of markets with external effects, but only where the economy produces and consumes a fixed number of goods and services. Economic theory does not have an equivalent theorem for cases where markets change; there are no results to explain what happens as new goods and services are introduced, as markets are enlarged to deal with goods and services that may be produced in response to the externalities themselves, or market failures. For example, successful and profitable new methods to measure – and new products to contain – gas emissions, such as catalytic converters, are outside the scope of the theorem. The trading of gas emission permits is also outside the realm of this theorem. Merck's and Shaman's new financial instruments designed to deal with the demand and the expected profits from the scarcity of biodiversity are not included either. In other words, our standard results that explain how the market fails in the presence of externalities themselves fail to explain the potential gains from market innovation.

Market innovation is the introduction and trading of new goods and services. It includes new financial instruments such as those observed emerging on Wall Street, tradeable permits, equity and/or profit-sharing deals. Indeed, market innovation occurs rapidly in financial markets. Market innovation often deals with the allocation of property rights by fiat: the firm that introduces a new financial instrument is its first owner. Questions of equity and efficiency are blurred in the process of market innovation.

The economics of externalities and property rights is central in this context. R. H. Coase has pointed out that the inefficiencies induced by externalities could be eliminated by the proper allocation of property rights.[8] In this context, once all property rights are assigned, the market operates efficiently. For example, the recognition that an individual has the right to clean air, which is the allocation of a property right to an individual, leads to legal rights and claims that were not possible before, such as lawsuits against industrial air polluters and nonsmoking in airplanes and public areas. This new right defines in turn a new market in which trading can take place, trading of clean air rights such as emission permits. The argument is that the new market resolves the externality, and the main theorem of welfare economics now assures the efficiency of market allocations. However, this may require a very comprehensive, even unrealistic, allocation of property rights. In an extreme case, the universe would have to be neatly parcelled out into individual assignations of property rights for the market to function efficiently. K. J. Arrow has pointed out that there may be externalities in the negotiation of property rights themselves which may make this process highly unlikely to succeed in practice.[9] He argues further that "the problem of externalities is thus a special case of a more general phenomenon,

the failure of markets to exist."[10]

But the observation we make here, which Coase and Arrow have not made, is that the new property rights, whether perfectly defined or not, may themselves lead to market innovation. Or, if in Arrow's terms certain markets fail to exist, market innovation in other areas can rise to the occasion. Innovation means markets for new products, goods and services that emerge to deal with the new rights, such as filters, catalytic converters, electrical batteries and engines. They may lead to new technologies and ways of doing business, and generally to higher levels of productivity. This may occur when the assignment of rights, by regulation or otherwise, has the property of leaving market behavior up to individuals and allowing them to proceed with their best, decentralized economic behavior. The examples provided above fit into this category. In other words, when externalities are properly regulated they often induce market innovation. This requires a special type of regulation: predictible, with long lead time, and not interfering with free technology choices and trading.[11] This leads to technological ingenuity, to genuine innovation, to the introduction of new goods and services, and generally to more productivity. All of this can occur in the context of competitive and free markets. Indeed, it is in such markets that innovation may occur more readily, provided *intellectual* property rights of innovations are respected. Market innovation therefore has the potential of reconciling active policy-making with the unfettered functioning of efficient markets. It is up to us to refine and develop the economics of market innovation to capture these gains in practice. The rewards could be enormous: allowing us to reconcile a livable planet with efficient markets.

Notes

1 G. Chichilnisky and G. M. Heal, "The Rain Drain," *Hermes* (Spring 1992): 26.

2 G. Chichilnisky and G. M. Heal, *The Evolving International Economy* (Cambridge: Cambridge University Press, 1987).

3 G. Chichilnisky and G. M. Heal, *Oil in the International Economy* (Oxford: Oxford University Press, 1991).

4 Michael Porter, *New York Times*, September 8, 1992, C8.

5 Chichilnisky and Heal, "The Rain Drain."

6 K. J. Arrow and C. Fisher, "Environmental Preservation, Uncertainty and Irreversibility," *Quarterly Journal of Economics* LXXXVIII, No. 2 (1974).

7 G. Chichilnisky and G. M. Heal, "Financial Markets for Unknown Risks." Working Paper, Columbia University, 1992.

8 R. H. Coase, "The Nature of Social Costs," *Journal of Law and Economics* (1960).

9 K. Arrow, "The Property Rights Doctrine and Demand Revelation under Incomplete Information," *Economics and Human Welfare* (New York: Academic Press, 1979).

10 Arrow and Fisher, "Environmental Preservation," 59.

11 Porter, *New York Times*.