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POLICY BRIEF

FINANCING GLOBAL ENVIRONMENTAL FUTURES: USING FINANCIAL MARKETS AND INSTRUMENTS TO ADVANCE ENVIRONMENTAL GOALS

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BY GLENN YAGO

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INTRODUCTION

The double entendre in the title of this paper is quite intentional. In order to finance the future of a sustainable environment, the application of financial technologies that allow for the valuation and pricing of anticipated returns and expected growth from environmental "externalities" (as a means of pricing and mitigating them) needs to occur. Options, futures, hedging strategies and a variety of hybrid financial instruments that evolved in other areas of capital markets are readily applied to what can become an environmental services industry.

Creating optimal capital structures of instruments that will finance environmental growth and maximize the shareholder value of environmentally based enterprises is long overdue. Building the bridge to an adequate pricing mechanism for the environment requires mobilizing these proven financial innovations for creating and developing environmental markets. The evolution of these markets promises great hope for emerging countries whose natural resource base, under adequate stewardship, provides them with a comparative advantage in attracting capital flows to support environmental and economic sustainability.

The burning of fossil fuels and massive deforestation continue to contribute to global warming and the controversy surrounding this phenomenon. Global climate change may cause more volatile and extreme weather, sea level rise and coastal damage, spread of infectious disease and expansion of deserts. Solutions include limits on greenhouse gas emissions by increasing energy efficiency and enhancement of carbon-absorbing "sinks" such as the world's forests and improved farming management practices. Rapid loss of the world's rainforests also threatens an enormous loss of diverse plant and animal species as well as undiscovered keys to human well being, such as new medicines.

Healthy rainforests and wilderness areas provide vital global environmental services by sequestering carbon from the atmosphere and acting as a store for global biological diversity. The mobilization of private resources through financial innovation can preserve rainforests, natural environments, and reduce the possibility of destructive climate change.

The global stock of natural capital – nature's ecosystems and the goods and services they provide – have decreased at an equally rapid rate. Virtually 60 percent of the world's tropical rainforests have been cleared and 40 percent of coral reef systems have been destroyed or seriously degraded. Moreover, one-third of the world's freshwater fish, one-quarter of all mammals and amphibians, and one-eighth of Earth's plant and bird species face extinction.

The environmental systems to support biodiversity are indispensable for human survival. Food, water, medicines, and materials for shelter and amenities all derive from the environment. This tie is particularly strong among rural and indigenous communities. The destruction of biodiversity, disrupting the supply of food and traditional medicine, increases poverty.

Agriculture, medicine and industry all depend upon biological and environmental diversity. A group of economists and biologists recently estimated that humans derive between $16-54 trillion per year, averaging $33 trillion per year, from ecosystem services – compared to a global GDP of $29 trillion.[1]

The links between business, biodiversity and the environment are converging. Certification systems are increasing, such as certified timber and certified organic products. "Green trade," promoted by certification, helps pay for the added costs of sustainable production methods and improves investor returns for companies providing those goods.[2] The natural and health food industries have achieved a 22 percent growth rate with sales reaching $12 billion annually. Organic products have shown similar growth rates. The demand for certified timber is increasing 50 percent annually, and retails sales of "green" products have jumped 233 percent over the past 10 years. "Green" sales are expected to total $30 billion by 2005.[3]

The successes of the past decade demonstrate the benefits of using financial technologies to solve large-scale, persistent environmental problems. For instance, active trading, public prices and clear incentives contributed to static and dynamic efficiency and innovation in reducing pollution at far lower cost than predicted. Once initial rudimentary programs were in place, more refined trading mechanisms for reducing pollution through the issuance of a limited number of quasi-property rights ("cap and trade" approach to pollution trading), proved to be highly successful. Market mechanisms allow emission sources to meet their emission reduction commitments either in-house, or, if less costly, to pay others to reduce or sequester emissions elsewhere. This demonstrates that applying principles of corporate finance and economics – efficient use of scarce capital, price transparency and lowering transaction costs – to environmental issues, aligning the interests of consumers, producers, and the general public, can result in improved environmental outcomes.

Economic growth appears to be a necessary condition for environmental protection, rather than its ultimate nemesis. Limitations on growth in transition and developing economies continue to threaten the capacity of those economies to pursue environmental protection as policy goals. As income and productivity rises, per capita expenditures on pollution control and environmental protection increase.[4] Crises, both financial and environmental, tend to occur when resources are not owned. Environmental problems represent the famous "tragedy of the commons." Whether the issue is overgrazed pastureland or the atmosphere, these resources are "owned" by everyone and thus effectively by no one, and so can be used indiscriminately by all. Under these economic circumstances, each person has an incentive to consume as much as possible as fast as possible, rather than to preserve and protect resources for future use. Conversely, actual or potential owners have incentives to use resources efficiently through enhanced returns on their investment and maintenance or appreciation of their property's value over time. It is the ownership gap – and resulting excessive "agency costs" – that creates problems in the financial performance of firms, specifically in regards to the environment.[5]

The theoretical resolution of this economic dilemma can be derived from the groundbreaking work of Nobel Laureate Ronald Coase on negative externalities and social costs.[6] His work clarified the significance of transaction costs and property rights for the institutional structure and functioning of the economy, a structure that had been previously assumed in economics. In his now famous "Coase Theorem," he demonstrated the importance of clearly defining property rights and their transferability as a mechanism of efficiently allocating resources. The theorem states that when property rights are well defined and "transaction costs" are zero, market participants organize their transactions in ways that achieve efficient outcomes. If by agreement the transaction costs of transferring property rights from one holder to another is zero, then the use of resources does not depend on whether the right was initially allotted to one party or the other (except for differences which arise from the distribution of wealth). If the initial holding entailed an unfavorable total result, the better result would be brought about spontaneously through a voluntary contract, since that contract can be executed at no cost and both parties gain from it. In short, in a friction free world, where there are no "transaction costs," it doesn't matter which side is given the rights, because the two parties can always make a deal.[7] By creating a property right concerning "negative externalities" or costs that could not be internalized into the production function, the public and social costs of private production could be priced and paid for through a market exchange.

"Market failure" is an imprecise phrase referring to the inability to apply market-based policy solutions to the environmental arena. More specifically, it is the overall inability to create and build a market to accommodate these exchanges. Markets are hampered because buyers and sellers lack information about available supplies and demand, and uniform quality is not guaranteed. This is as true for recyclables, water and greenhouse gas emissions today as it was for corn or rice in earlier times. By patterning environmental markets after the market-building behavior of those earlier markets environmental markets can establish a coordinated process for trading their commodities and emerge more aggressively.

Further breakthroughs in economics have occurred on the cutting edge between mathematics, biology, and game theory to map complex systems about the behavior of linked ecological and economic systems. These insights enhance our ability to quantify sustainable patterns that work in synergy with life-supporting ecosystems.[8]

The application of market-based solutions to environmental issues covers several objectives that are interconnected. In this context, risk management and hybrid financial instruments integrate capital, commodity and environmental markets by:

- Expanding markets in tradable emissions permits (SO2, greenhouse gases, and other pollutants);

- Developing an ecosystem services market (market-based incentives to monetize biodiversity and its prospecting, ecotourism, water quality, etc.);
- Monitoring information and innovation to enhance market development.

These measures do not eliminate regulation, but create a regulatory regime that promotes market-based solutions rather than costly and ineffective command and control policies. In short, regulation is restructured, not eliminated.

INVENTING THE ENVIRONMENTAL MARKET

Shumpeter's model of inventive activity for economic development applies clearly to environmental markets. Invention, innovation and replication are required for the development and application of financial technologies. Richard Sandor has identified a seven-stage process for market development generally and as it applies to the environmental services market:[9]

- A structural economic change that creates a demand for new services;
- The creation of uniform standards for a commodity or security;
- The development of legal instruments that provide evidence of ownership;
- The development of informal spot markets (for immediate delivery) and forward markets (non-standardized agreements for future delivery) in commodities and securities where "receipts" of ownership are traded;
- The emergence of securities and commodities exchanges;
- The creation of organized futures markets (standardized contracts for future delivery on organized exchanges) and options markets (rights but not guarantees for future delivery) in commodities and securities; and
- The proliferation of over-the-counter markets.

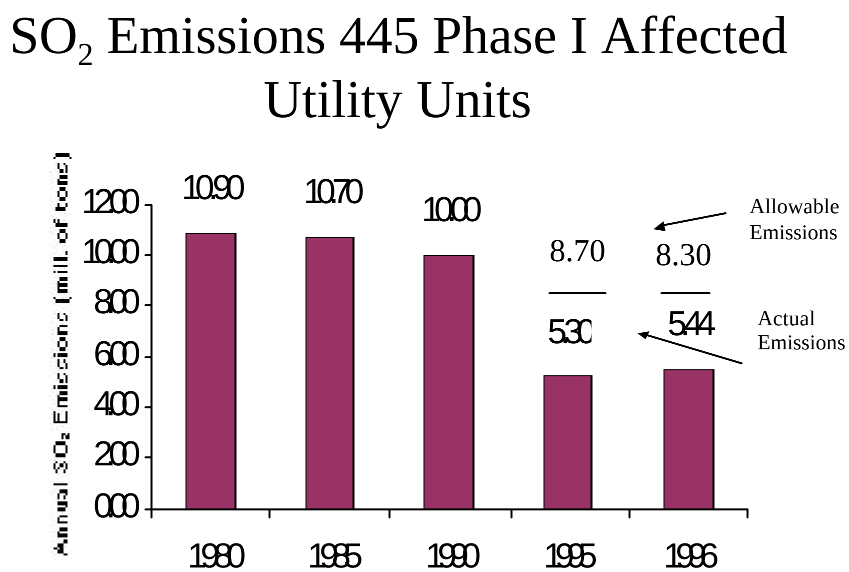
There is considerable evidence that such a market-based strategy has numerous advantages over the command-and-control approach more often extended to natural resources. Attempts to impose predictability or stability by command-and-control regulation alone have resulted in reductions in the natural variation of resource systems. Market based solutions, utilizing existing financial instrumentation reconfigured for these environmental objectives, overcomes those problems.[10]

FROM SULFUR EMISSIONS TO CARBON CREDITS MARKETS: MAXIMIZING CAPITAL FLOWS FOR ENVIRONMENTAL MARKETS

The U.S. sulfur dioxide emissions market was the first effort to systematically apply financial innovations to environmental deterioration mitigation. In 1990, Congress placed an overall restriction on power plant emissions nationwide enable power plants to comply by either investing in cleaner fuels or pollution control technologies or buying extra emissions rights from another power plant that made extraordinary emission cuts. Buying excess rights enables older, less efficient plants to meet obligations. Emissions goals are thus met at the least cost.[11]

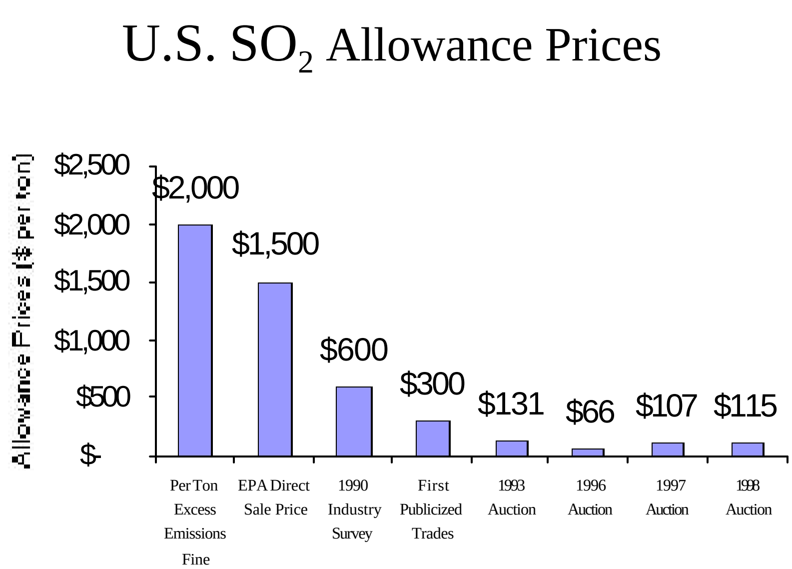
In 1992, estimates of emissions rights ranged from $981 to $1,500 a ton. By 1998, the Chicago Board of Trade auctioned off a large number of allowances at $115 a ton. Improved technologies for burning low sulfur coal, improvements in electrical generating efficiency, and lower fuel costs accompanied emission rights in dramatically lowering these costs.[12] By 1998, actual sulfur emissions averaged 30 percent below allowable levels. Inter-utility trading of allowances increased from 700,000 in 1995 to 2.8 million in 1997. Savings of $785 million are estimated for 2000 and the net cost of the cap and trade system is 43 percent of the estimated costs of a command and control system (Illustrations 1 and 2).[13]

Illustration 1



Source: Dr. Richard Sandor - Environmental Financial Products, Ltd

Illustration 2



Source: Dr. Richard Sandor - Environmental Financial Products, Ltd

THE ECONOMIC IMPACT OF LOWERING EMISSION REDUCTION COSTS: GREENHOUSE GASES AND RELATED RISKS

Unknown risks are risks whose frequencies we do not know, and for which we are aware of our ignorance. Examples of these risks are environmental health risks induced by scientific uncertainty in predicting the frequency and severity of catastrophic events.[14] The volatility of weather, taken together with population movement to warm coastal areas and changing property prices has made catastrophic risks highly unpredictable. Roughly 70 percent of the U.S. economy is vulnerable to abnormal weather patterns. Indeed, the market for weather derivatives has grown for businesses that are particularly sensitive to weather uncertainties. Weather derivatives allow businesses sensitive to the vagaries of weather to protect themselves against changes in costs and sales linked to variations in climate. Greenhouse gas emissions underlie all of these problems. While some do not believe carbon emissions contribute to global warming and extreme weather and health problems, everyone agrees that carbon emissions are increasing rapidly. Since carbon emissions increase the likelihood of significant climate change, a carbon trading system provides low cost global risk insurance against larger societal, economic and health problems.

Sandor and Walsh (1997) have demonstrated the impressive economic benefits of driving down the cost of cutting greenhouse gas emissions. The industrialized world can make dramatic strides in bringing down greenhouse gas emissions at small costs utilizing financial innovations that drive down compliance costs. The goal of lowering U.S. emissions to 10 percent below 1990 levels requires a reduction of 323 million metric tons carbon equivalent (mmtce). At a reduction cost of $100 per ton, the annual U.S. cost would total $32.3 billion. Alternatively, $20 per ton drives costs down to $6.5 billion or less than 0.09 percent of the U.S. national income or 1.3 percent of the U.S. energy bill. This price is in the range of proposed offset transactions and the level at which many analysts believe large emission reductions would be generated.

The greenhouse gas-trading program moves environmental policy from being a drag on the economy to being of low-cost impact. The benefits and "new economy" developments associated with environmental services – information technology applications to environmental monitoring – create the conditions for new economic sectors related to the environment to emerge (Tables 1 and 2).[15]

Table 1

Annual Cost to Cut GHG Emission 10% Below 1990 - Assumed Price of $20/Ton of Carbon

	Required Cut (mmtce)	Total Cost ($Bill)	% of Year 2000 National Income (Nom GDP)
USA	323	$6.45	0.072%
EU	68	$1.35	0.015%
Japan	43	$0.87	0.014%
Canada	27	$0.54	0.073%
TOTAL	461	$9.21	0.037%

*Assumes allocation and compliance parameter analogous to the U.S. sulfur dioxide allowance system. Projections of year 2000 emissions are based on latest available estimates for the U.S. (1,758 mill. Metric tons carbon equivalent) and Canada (166 mmtce). Projects for Japan (340 mmtce) and the EU (1,083 mmtce) are from FCCC projections. GDP projections assuming nominal (current price) GDP grows 5% per year from 1993 through 2000.

Table 2

Cost of Offsetting 25% of Carbon Emissions at $20 per Metric Ton Carbon

	1 Gallon of Gasoline	1 Megawatt Hour U.S. Electricity
Carbon Emissions	5.33 Pounds	436 Pounds
25% Carbon Offset	1.33 Pounds	109 Pounds
Cost to Offset at $20/Mt	$ 0.012	$ 0.99
U.S. Retail Price	$ 1.25	$69.00
% Price Increase	1.0%	1.4%

*Assumes use of tradable permits system with allocation and compliance parameters analogous to the U.S. sulfur dioxide allowance trading program.

A system of quotes, hedging and options will evolve as it has in other markets. The market for carbon trades is already evolving. Niagara Mohawk, an electrical power company in New York State, and Arizona Public Service completed a swap of carbon offsets for sulfur dioxide emission allowance in 1996. Environmental Financial Products purchased rainforest protection carbon offsets from the Republic of Costa Rica in 1997. This 1.1 million-acre program also includes assurance from the Costa Rican government that the area will be placed in a national preserve. In 1998, Japan-based Sumitomo began converting coal-fired electrical power plants in Russia to natural gas to earn carbon offsets as part of a fuel-switching transaction.

This suggests enormous opportunity for the gas industry. Per unit of energy, combustion of natural gas results in 42 percent less carbon dioxide emission than coal and 29 percent less than residual fuel oil. Significant reductions in carbon dioxide emissions could be made from fuel switching. Added to the value of SO2 and NOx reductions resulting from switching to natural gas, the financial premium associated with the environmental benefits are even greater. With the price signals affected by carbon trading, price incentives will encourage new technologies that produce, distribute and burn natural gas more efficiently.[16]

IMPLICATIONS FOR U.S. FARMERS AND AGRICULTURE: HARVESTING CARBON SEQUESTRATION IN THE AGRICULTURAL SECTOR

With a market evolving for greenhouse gas emissions, those emitting carbon will either pay to sequester it (remove carbon from the atmosphere) as a permanent offset to emissions or invest in technologies that will reduce it. Firms could use a combination of reducing emissions and offsets with carbon trades. Improved soil management practices increase the agronomic productivity of U.S. cropland, reduce soil erosion, and improve water quality and wildlife habitat.[17]

Prices signals that encourage farmers to sequester additional carbon could evolve into new technologies in seed, tillage and conservation. Bioengineering plants to capture more carbon or management practices associated with agriculture and forestry are among these. Lal, et.al. estimate the overall potential for carbon sequestration using U.S. cropland to be 120-270 million metric tons of carbon per year (MMTC/yr). Best Management Practices (BMPs) would generate savings of around 100 MMTC/year with the remainder coming from acreage conversion and bio fuels. Worldwide carbon emissions are growing by about 3,000 MMTC/yr. U.S. cropland could be used to reduce projected annual increases in carbon by about 7 percent or 30 percent of the U.S. share under the Kyoto protocol.[18]

Minimum and no-till systems can sequester more carbon. Only about 37 percent of our arable land was under conservation tillage. Excessive tillage created a situation where corn belt soils held about 61 percent of the carbon they had in 1907. Lal estimates that Best Management Practices – reduced and minimum tillage systems – would dramatically increase carbon sequestration over the next 50 years. Using lower-end estimates ($20-30 per ton) of the value of carbon emissions allowance, paying farmers to sequester could add $4-6 billion of gross income annually to the farm economy, fully10 percent of net farm income. A ton of soil organic carbon can be captured and added in four to five years. This could soften farm income cycles, removing marginal agricultural lands from crop production and putting it into conservation when relative prices favor carbon sequestering over food production.[19] Rather than utilizing tax dollars for transfer payment models, a.k.a. "green support payments," carbon capture would pay farmers to sequester carbon and provide an incentive for monitoring carbon management. These new "crops" of carbon capture for the international environmental service market would reduce the greenhouse gases that affect extreme weather and the long-term weather problems that effect farming.

Low-costs systems to monitor and manage carbon in soils generating effective baseline data would enable the verification this process requires. Farm cooperatives, grain merchandisers, biotech firms and agribusinesses could develop a wholesale market for carbon sequestering. An advisory role for the USDA and the development of Best Management Practices could produce rewards for estimates for carbon sequestration.

EMERGING ECONOMIES AND EMERGING ENVIRONMENTAL MARKETS

Reduction and sequestration are both means that enable developing economies to create capital flows into the emerging international environmental services sector. The evolution of the north-south greenhouse gas mitigation market established in 1997 under the Kyoto Protocol (Article 12) enhances sustainable economic development. As Walsh (1999) explains, flexibility is key to reducing net greenhouse gas (GHG) emissions and encourages cost efficiency in approaching the problem of climate change. The Clean Development Mechanism (CDM) allows both developing and industrialized economies to benefit from projects that mitigate greenhouse emissions in developing countries. These include rainforest conservation and reclamation, eco-tourism and biodiversity prospecting. Under this program, "certified emissions reductions" (CERs) are carbon credits created when a project in a developing country causes a reduction in emissions.

Post-Kyoto follow-up meetings of the United Nations Framework Convention on Climate Change in Buenos Aires (1998) and Bonn (1999) began to establish detailed rules for the trading mechanism. As noted, the CDM, once established, might generate capital flows of more that $10 billion per year into the developing economies.[20]

A complementary benefit of the capital flows enabled by financial technologies applied to this set of environmental problems is that it will be a tool to "green" the path of long-term economic development. This will give energy and manufacturing facilities incentive to lower their environmental impact as their countries will benefit from sustainable development.

The demand side of the GHG mitigation market reflects voluntary or imposed mandates. An electric power plant that burns coal may have a commitment to reduce its GHG emissions by 10,000 CO2 tons per year. The plant could switch to natural gas or "outsource" its mitigation in two ways: by paying to have carbon-absorbing trees planted in its own country (or elsewhere) or by buying credits earned by projects that reduce emissions in developing countries. Walsh illustrates the economic incentive embedded in this process through a useful example:

> Suppose a cement producer in Brazil found that it could cut its GHG emissions from 60,000 tons (its emission "baseline") to 50,000 CO_2 tons per year by upgrading the electronic energy controls on its manufacturing process. If the power company in the industrialized country and the Brazilian cement maker both agree, the power company could help pay for the cement maker's plant upgrades in return for CDM credits the power company could use to demonstrate fulfillment of its mitigation commitment. If cutting its own emissions would have cost $100,000, but paying the cement maker to cut its emissions cost only $40,000, the power plant saves $60,000 but achieves the same amount of emission reduction. At the same time, the cement maker is more energy efficient and the release of other pollutants is also likely to fall.[21]

Standardization for the CDM trading system is critical as it has been for the development of every financial market employing these financial technologies. The measuring and monitoring of standard emissions thresholds would determine when a project is eligible to earn credits. Sectors and activities to which standardization can be applied include electric power generation; heating, cooling and lighting equipment; mining and metals production; cement and plastics production; oil and gas extraction and refining; pipelines; transport and shipping; reforestation programs and timber plantations.

Creating a standardized process for crediting new forests, forest retention and conservation in developing and developed countries is also important. Reforestation and expanded carbon sinks create additional premiums for the least developed countries to advance climate protection and combat desertification. Standardization in measuring and monitoring has been key in developing new market mechanisms through the capital markets and reducing transaction costs.

A global financial institutions initiative is currently underway to develop a meaningful international financial architecture for the evolution of this market. An international consortium of banks, insurance companies and financial services companies would contribute to the development and diffusion of projects, standards, policies, and programs to support GGH emissions trading.[22]

MONETIZING BIODIVERSITY: CREATING ENVIRONMENTAL EXPORTS

In the United States, nearly 25 percent of prescription medicines contain active ingredients derived from plants, while many other drugs are synthesized to replicate or improve naturally produced molecules. Leukemia is treated with medicines derived from the rosy periwinkle of Madagascar. The bark of the Pacific yew tree is the source of a promising treatment for ovarian cancer. "Biodiversity prospecting" offers an opportunity to sift among genetic and biochemical resources for commercial value. Capitalizing on new and better products for industrial, agricultural and pharmaceutical applications provides an important incentive for monetizing the value of biodiversity in the natural world, especially in developing countries where the majority of remaining plant species survive.[23]

Simpson (2000) focuses on three major aspects of biodiversity valuation: values generated by the continuing function of diverse natural ecosystems, values generated by new products from biologically diverse sources, and values generated by intangible ethical, aesthetic and spiritual uses of biodiversity.

There is considerable debate about valuation procedures for biodiversity. Some lower range estimates might be the result of inadequate medical research spending that would generate further value for biodiversity. Hence, we may find minimal estimates for the ability of a "marginal hectare" to preserve species as the result of inadequate application of species research.[24] This could substantially change in the coming decades of increased investment in biotechnology.

THE LINK BETWEEN SUSTAINABLE ECONOMICS AND THE CORPORATE FINANCE REVOLUTION—GOVERNANCE, TRANSPARENCY, AND GROWTH

The conditions necessary for financing the future are the same both for sustaining the global environment and for removing barriers to job and capital formation globally. Environmental finance represents a special, but not unusual case of the need to align interests of investors, entrepreneurs and consumers tied to various layers of capital structure for specific projects, markets, and commodities. Indeed, the conditions that promote environmental sustainability affect the sustainability of corporations as well.

The performance of the recently development Dow Jones Sustainability Group Indexes demonstrates this point. Sustainability-driven companies achieve their business goals by integrating economic, environmental and social growth opportunities into their business strategies. There is mounting evidence from the field of corporate finance and through this index that the financial performance of companies that pursue environmentally and economically sustainable goals is superior to that of companies that fail to adequately optimize these factors.

The Dow Jones Sustainability Group Index (DJSGI) is instructive. The DJSGI is composed of stocks from 33 countries grouped into 9 economic sectors and 73 industry groups. The Index tracks the performance of the top 10 percent of the companies in the Global Index that lead their field in sustainability. Sustainability refers to the company's pursuit to meet market demand for sustainable produces and services. Ecological, social and economic criteria are equally weighted. Annual reviews are part of the sustainability evaluation system that reviews a detailed questionnaire, corporate policies and reports, and closely examines environmental management systems and compliance with environmental standards. Not surprisingly, sustainable corporate strategies, programs and practices maximize long-term shareholder value (Illustrations 4-9).[25]

Illustration 4

Dow Jones Sustainability Group Index (DJSGI)

Performance - 5 year (Jan 1995 - April 2000; US$, Price Index)

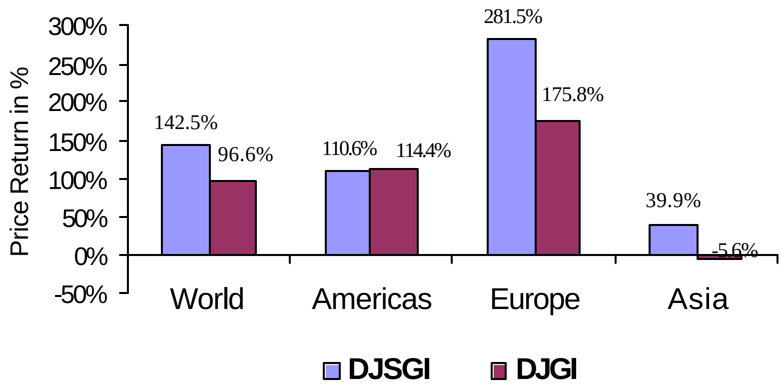


Illustration 5

Dow Jones Sustainability Group Index (DJSGI)

Performance - 5 year (Apr 1995 - Apr 2000; Euro, Price Index)

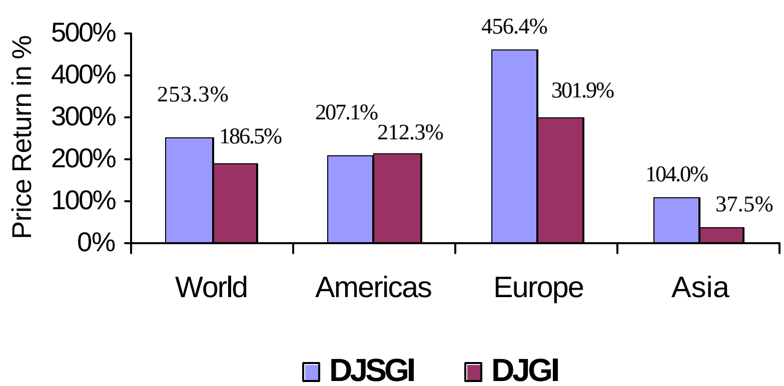


Illustration 6

Dow Jones Sustainability Group Index (DJSGI)

Sector Allocation (as of April 30, 2000)

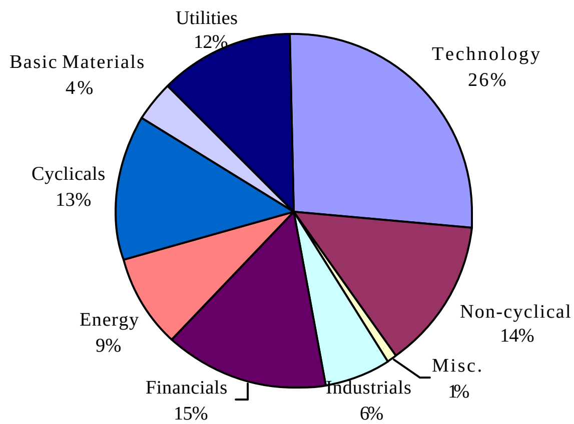


Illustration 7

Dow Jones Sustainability Group Index (DJSGI)

Country Allocation (as of April 2000)

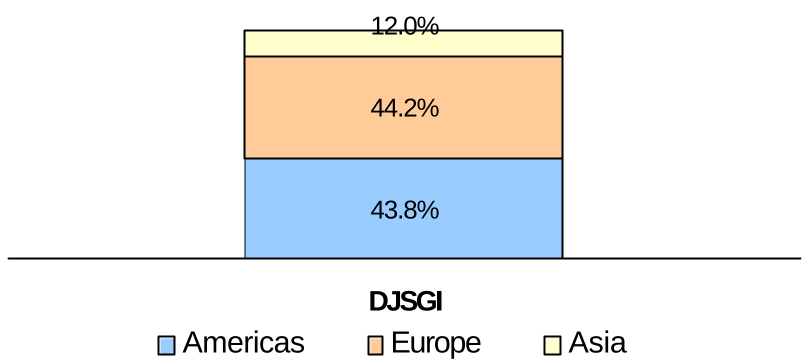


Illustration 8

Dow Jones Sustainability Group Index (DJSGI)

Risk / Return Profiles (5 Years: Apr 1995 - Apr 2000)

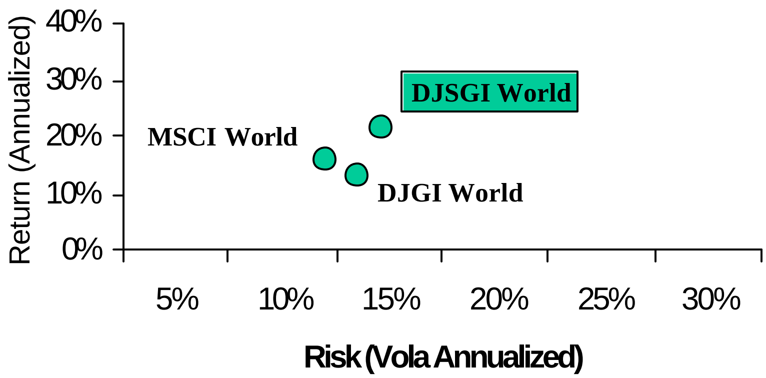
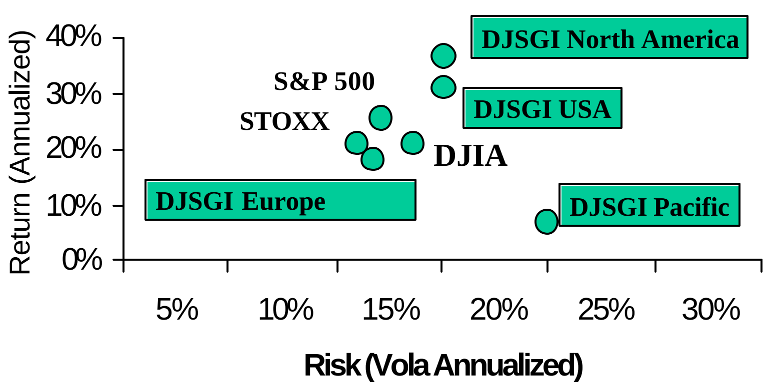


Illustration 9

Dow Jones Sustainability Group Index (DJSGI)

Risk / Return Profiles (5 Years: Apr 1995 - Apr 2000)



CONCLUSION

The lack of transparency in international finance is now widely acknowledged as a key underlying issue in ongoing financial crises and in financing economic development.[26] Nowhere is this more apparent than in issues of environmental economics and the ability of financial innovations to catalyze this important new market. The lack of transactional trust between market participants, information gaps that hobble adequate pricing, and inappropriate regulations, all converge to block investment flows that could provide higher yields for environmentally rich but capital poor countries. These problems are also reflected in the rural regions of developed countries and urbanized areas where brownfield problems persist New technologies allow capital poor countries to preserve and leverage their natural resource economies into more diversified ones as well as advance human development for economic growth. They are also useful in resolving problems of contingent land development for brownfields.

Fortunately, modern corporate finance and its application to financial institutions and capital markets provide a variety of financial technologies that address these problems. Still, polluting infrastructure continues to grow and rapid deforestation persists unabated. Continued delay in deploying financial innovation to reduce negative environmental impacts, financing global environmental futures, and enterprises that will deliver global environmental services, will prove dangerous to the health and continuity of plant and animal species, including our own.

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[1] Constanza, R. et.al. 1997. "The Value of the Word's Ecosystem Services and Natural Capital," *Nature*, 387:253-260
[2] See Reed, Donald J. 1998. "Green Shareholder Value, Hype or Hit?" *Sustainable Enterprise Perspectives*, World Resources Institute, September.
[3] Bayon,R., J. S. Lovink and W. J. Veening, 1999. *Financing Biodiversity Conservation.* Inter-American Development Bank, November.
[4] Brookshire, David S., Don L. Coursey, Howard Kunreuther and Marc R. Isaac. 1991. "Compensation Schemes for Negative Externalities: A Field Experiment," *Research in Experimental Economics*, Vol. 4. JAI Press, 81-106.
[5] Stroup, Richard and John Baden. 1982. "Symposium on Current Labor Issues: Market Failure, Collective Action, and Collective Failure: Introduction," *Journal of Labor Research,* Summer 243-45; Stroup, Richard and John Baden. 1973. "Externality, Property Rights and the Management of our National Forests," *Journal of Law and Economics,* October *16 (2),* 303-12.

[6] Coase, Ronald "The Problem of Social Cost," *Journal of Law and Economics*, 3:1-44; *The Firm, the Market and the Law*, Chicago: University of Chicago Press, 1988. This is not an argument against environmental regulation. Regulations can and have been positively detrimental to economic welfare in the capital markets, transportation and communications industry and elsewhere as the result of regulators who are captured by the incumbent firms and use their power to deter entry as Stigler anticipated. (George J. Stigler, 1964. "Public Regulation of the Securities Market," *Journal of Business*, 37:117-142; *The Citizen and the State: Essays on Regulation*, Chicago: University of Chicago Press, 1971). In fact, the environmental services market requires the ability of the judiciary to enforce property rights and efficiency enhancing contracts. In this specific case, as Coase writes, "there is no reason why, on occasion, such governmental administrative regulation should not be an improvement on economic efficiency." (Coase, 1988:118).
[7] Easterbrook, Frank and Daniel Fischel. 1991. *The Economic Structure of Corporate Law*, Cambridge, MA.: Harvard University Press.
[8] For example, see Constanza, Robert et.al. 1993. "Modeling Complex Ecological Economic Systems," *Bioscience*, September 43/8, 545-555; and Arrow, K. et.al. 1995. "Economic Growth, Carrying Capacity, and the Enviornment," *Science.* 268:520-521. April 28 and an important theoretical contribution by Frank Maier-Rigaud. 2000. *Under What Conditions are Decentralized Solutions to Collective Action Problems Likely?* Max Planck Project Group, University of Bonn, July.
[9] Sandor, Richard L. "Getting Started with a Pilot: The Rationale for A Limited-Scale Voluntary International Greenhouse Gas Emissions Trading Program," White House Conference on Climate Change, October 6. 1997.
[10] See Holling, C. S. and Gary K. Meffe. 1996. "Command and Control and the Pathology of Natural Resource Management," *Conservation Biology*, April 10/2, 328-337; Tietenberg, Tom. 2000. *The Tradable Permits Approach to Protecting the Commons: What Have We Learned?* Colby College, Department of Economics, September.
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