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Financial Instruments for Human Development

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1. Introduction

The rapid period of industrial growth since World War II gave rise to an unprecedented and uneven¹ use of the earth's resources. This led to mounting concerns about the scarcity of environmental assets such as water, fertile soil, and a stable atmosphere. There is an increased awareness today about the value that environmental assets have for human societies. Yet today's economic systems are "stacked up" against nature. They often reward the destruction of environmental assets such as forests for short-term economic gain, failing to provide value and incentives for the conservation of assets that could be extremely valuable in the

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¹Uneven because the use of resources is mostly concentrated in the industrial nations of the world, which house only 20% of humankind yet consume most of the world output of resources. For example, people in industrial nations consume ten times more energy than those in developing countries, and they use energy less effectively: they produce 37% of the world economic output yet they use 57% of the world's yearly output of energy.

future.² Economics often provides the wrong incentives to those who control the assets, such as people in developing countries where most forests are located and who could potentially benefit most from conservation. There is increasing unease about this situation, and an emerging view is that standard economic concepts and prescriptions fail to properly account for the value of environmental assets. Economic values seem to be out of step with social values; it is clear that the economic science of the future should bridge this gap. *This paper develops practical ways and new economic thinking to redress this discrepancy: it creates and develops structures and institutions through which the value embodied in environmental assets can be translated into economic return which encourages the conservation of the asset, and induce more equitable and effective use of resources.*

I will introduce a range of different financial instruments, some of which are connected to *global* environmental assets such as the planet's atmosphere, and others to *local or regional* assets, such as watersheds. The financial instruments proposed here all share an unusual feature: they provide economic incentives towards environmental conservation. They do so by altering the economic valuation of these assets in a way that is more aligned with their real values to human societies. By doing so, these mechanisms produce incentives towards more efficient use of resources globally, whether for local resources such as water or for global resources such as a stable atmosphere. The ultimate role of these instruments is to offer a way to fund sustainable human development at a global scale, systematically and reliably.

Some of the financial instruments proposed here can be introduced, regulated and traded through a new institution: an International Bank for Environmental Settlements (IBES), a framework that I proposed first in 1994, and part of which

²Examples are provided below.

was created by an agreement reached by 166 nations in the Third Convention of the Parties of the UN Framework Convention for Climate Change in Kyoto, December 1997.³

The blueprint I proposed for the IBES would have it organize and monitor a range of activities that appear in principle very different, yet share a role of providing a global financial infrastructure to encourage sustainable economic progress across the world, among others:

- Newly created emissions markets for controlling the atmospheric concentration of greenhouse gases, prominently those associated with the burning of fossil fuels
- Securitizing profit sharing agreements on genetic blueprints
- Securitizing profitable investments in aquifers, watersheds, biological soil enhancement, and fisheries
- Trading rights to use the global airwaves⁴
- Providing intermediation, bridge financing and credit enhancement facilities for all of the above
- Ensuring transparent, equitable and efficiency transactions

A global vehicle such as IBES can be coupled with more conventional methods

³Article 6 of the Kyoto Protocol, paragraphs 1 and 5.

⁴The spectrum is an environmental asset, and one that is not used optimally today. Congestion is building up: it is overused in a similar way that the atmosphere is. The development of world standards for this resource can make better use of it, and trading the rights to use different parts of the spectrum (as done in Washington for national usage) could lead to less congestion, better use and more value in the future.

for creating economic incentives for conservation at the *regional* or *national* levels, such as:

- Subsidies (such as investment tax credits) for research and for the adoption of cleaner and more efficient technologies, and
- Carbon taxes and other taxes which internalize costs involved in environmental use.

A somewhat unusual role for the instruments proposed here deserves to be highlighted: *they encourage the conservation or even the enhancement of environmental assets*. Common wisdom often identifies finance with the pursuit of immediate gain rather than with overall positive outcomes. Nevertheless there exist instruments of public finance that aim at improving social welfare, such as mortgages that make housing more accessible, or bonds for building social infrastructure such as public transportation. Yet the most important insight on the innovative financial instruments proposed here is that they are constructed in a way that changes private behavior, reversing *individual* incentives existing today that encourage the destruction of environmental assets, and creating instead incentives and values that encourage conservation while offering economic return. These instruments differ from other uses of public finance in that they change private behavior without direct government action,⁵ in an area in which only changes in individual values can make a difference.

⁵Public finance is about raising finance for the development of public goods that are generally produced by governments, such as roads, transportation systems, and other public projects. These projects are generally provided by governments in a centralized fashion. Here we refer to finance that is raised to change individual behavior towards the production of privately produced goods, such as carbon emissions which are a by-product of using one's car or even breathing. Both of these are private activities that the government does not normally interfere with.

Another unusual characteristic of the financial markets proposed here is that *in order to achieve efficient market solutions the burden imposed by the emissions ceilings which are needed before countries trade, must be born in an equitable fashion.* More precisely: those who have lower endowments of private goods should typically be given more rights to use the environmental assets. Somewhat surprisingly, this helps achieve market efficiency as usually defined in economics.⁶ This is a new finding, which differs from the standard welfare results involving the efficiency of competitive markets, and is reported in Chichilnisky (1993), Chichilnisky and Heal (1994) and Chichilnisky, Heal and Starrett (1993). This new result is due to the fact that markets involving rights to use environmental assets (such as permits to emit carbon dioxide) trade typically *privately produced public goods*.⁷ These types of goods differ from standard private goods in that the consumption of different traders is not independent from each other. This induces a connection across traders that does not exist in standard markets, and requires more equitable⁸ allocations of property rights in order to achieve market efficiency. This new finding imposes more demands on the functioning of the market, since it requires it to monitor equity in the allocation of rights as well as fair trading: this translates into the correspondingly requirements for the IBES. At the same time, this means that the instruments proposed here are more favorable to developing countries than it is generally the case with standard

⁶This refers to Pareto efficiency, also called first best efficiency. By contrast, competitive markets for private goods lead always to efficient outcomes, quite independently from the distribution of rights: this is the first welfare theorem of economics which formalizes Adam Smith's vision of the "invisible hand."

⁷These are *public goods* in the sense that traders cannot choose the amounts independently from each other, yet they are *privately produced*.

⁸The word "equitable" has several possible meanings: here it is used to mean a somewhat more equal distribution of assets.

financial markets: to function properly a preferential role should be given to lower income countries in terms of initial allocations of rights. This is a reason for the IBES to be favorably viewed by developing countries, provided however that the equity principle established here is built into the modalities, rules and monitoring of the international framework for trading emissions.⁹ This important new insight into the functioning of environmental markets has not yet been taken into account in the global negotiations. There are good reasons to believe that when it is incorporated, it will facilitate the negotiations among industrial and developing nations. The actual rules and modalities for the functioning of the emission markets will be decided in COP4 in Buenos Aires, November 1998, and it is hoped that by then or soon thereafter an understanding of the crucial role of equitable allocations in these markets is brought to the negotiations.¹⁰

The main message of this article is that we must rethink the foundations of international development to achieve equitable and sustainable economic progress. The Bretton Woods Institutions (World Bank, IMF, GATT) were based on a post World War II model. They encouraged one form of development: resource-based industrialization. These organizations are built upon a model funded by voluntary national donations based on taxes, a model that no longer works well. Governments are increasingly pressed to balance their budgets, and voters resist paying taxes for voluntary government donations.

At the same time the globalization of the world economy brings new demands on the international system, requiring more infrastructure for trading and communication, and the need to develop new standards of human development and environmental protection. The current criticism of the Bretton Woods institutions, and of the United Nations within the US and other industrial nations,

⁹ Agreed in Article 6 of the Kyoto Protocol.

¹⁰ For an exposition on this point see Chichilnisky (1996).

comes at a time when international organizations may be more needed than ever.

The answer could be to develop a new breed of international institutions which can provide the global services and infrastructure needed for the new global economy, but rather than relying on voluntary donations based on taxes, charging on a fee-for-service basis. The IBES could be the first such global institution. It could

- Mobilize private finance acting as an intermediary
- Offer credit enhancements, bridging loans and securitization to bring private finance to bear in risky and long term development projects or activities in developing countries that appear too risky to the private investor
- Support the creation of new markets (e.g. for emissions trading) and new products (e.g. securities based on the future value of watersheds or biodiversity) as needed.

2. Water: a regional environmental asset

Water provides a good example of an important environmental asset that is supplied regionally or locally, yet it reflects an environmental problem that is global because it arises in practically every large human settlement across the world. This section will use water to illustrate the problem; later sections will show how a global institution such as the IBES can provide a solution.

Natural drinkable water has zero value in most national accounting¹¹ systems: it has no market price because there are no established markets for water. Yet according to the World Bank natural sources of drinkable water are the most

¹¹I.e. in reports of Gross National Product or GDP. Bottled water is sold in the marketplace and has a commercial value, e.g. Perrier.

scarce resources in the world today, and gallon by gallon the real cost of obtaining drinkable water today is larger than that of petroleum.¹² There is no need to emphasize the importance of drinkable water for human societies.

Most drinkable water comes from watersheds, which collect water and provide filtration through microorganisms in the soil. As water becomes more and more scarce, watersheds provide an increasingly valuable service. Nevertheless financial markets do not offer a chance to invest in the future gains involved in preserving a watershed that produces very efficiently and inexpensively drinkable water for millions of city people. By contrast, the short-term economic benefits involved in exploiting the area around the same watershed for agriculture or for development of real estate, activities that decrease the ability of the watershed to filter water and are less rewarding in the long-run, are easier to capture by a few people involved in food production or real estate development. One can raise capital, obtain loans or sale equity to finance real estate projects using standard financial instruments such as bonds or securities available in today's capital markets. Investing in the future value of the watershed services, on the other hand, is nearly impossible today. The financial instruments do not exist, nor does the business and economic understanding of how to achieve this goal. This is why financial mechanisms today are "stacked" against nature.

This bias against nature occurs because western societies have only recently become aware that resources such as drinkable water are truly scarce and valuable, and our economic systems are rather slow to adjust. This is not surprising, for economic understanding and systems reflect the past more often than they reflect the present.¹³

As already mentioned this paper address this issue, bringing up to date exist-

¹²reference.

¹³This observation is due to J.M.Keynes.

ing economic systems so that they reflect today's realities. *In later sections the paper develops financial mechanisms through which the enormous economic value embodied in environmental assets such as watersheds can be translated into immediate economic return in a way that encourages simultaneously the conservation of the asset itself.*

It will be shown that these financial mechanisms are often more successful when taken globally than when trying to solve one problem at the time because the law of large numbers allows to distribute risks in a way that improves the economic returns of the financial instruments, and therefore makes them more attractive to investors.

3. The basic economic concept

The economic concept proposed here is simple and by no means novel. Any asset that has large future value can be transformed into a stream of income today. Environmental assets are no exception.

A role of financial markets is to bring future benefits into the present. Additionally, capital markets perform the useful role of bringing liquidity to the market by allowing private investors to make their savings available for such projects. Examples of financial instruments that bring future gains into the present are not difficult to come by: schemes to raise venture capital for developing a valuable new product that will yield large profits when it penetrates the market, or the use of asset-backed securities to raise money secured against rental property. Both schemes translate future value into income today.

There is another important role of these financial instruments: in each case they encourage the *conservation* or even the *enhancement* of the underlying asset, such as the building against which the capital is raised. In the environmental

arena, this analogy may be the most important insight on the role of financial instruments: they can encourage conservation while offering economic return today. This dual role (providing return and encouraging conservation) is the solution to today's dilemma in developing nations, who house most of the world's remaining environmental assets. Properly designed and developed, financial instruments can help developing nations to achieve economic progress without destroying the natural infrastructure on which their societies are built. *Because today's use of natural infrastructures is often inefficient, this process produces net gains to society as it improves overall efficiency.*

In simple terms, the aim of this paper is to use existing tools of economic analysis in a non-standard manner: to develop a way of transforming the future value of important environmental assets, such as a forests or watersheds, into a stream of income which is available today and which encourages the conservation of the underlying asset and surprisingly improves overall economic efficiency. The ultimate aim is:

- Achieving sustainable human development
- while
- Limiting exploitation of natural resources to sustainable levels.

4. The need for new economic thinking

Since environmental destruction is associated with industrialization, most of the world's remaining environmental resources are located in developing nations which have not yet completed their process of industrialization. As they industrialize the stress on resources becomes global. For example, most of the remaining biodiversity of the planet, about 90%, is in developing countries, within forests and

other natural ecosystems. Yet a typical way for developing countries to obtain economic value from their forests is through the harvesting of trees. Since this can be a capital intensive task, this is often carried out by wealthy corporations which come from afar. These are typically not aligned with the needs of the local population, who have co-existed with the resource and therefore know its dynamics and vulnerabilities. Foreign corporations seek to maximize short term gain, and often lead to unsustainable harvesting of the resource and eventually its destruction. The problem is quite general: developing nations face the economic needs, and are often unable to resist the economic use of their resources in a way that increases economic progress while destroying the asset itself. Very few corporations, mostly within the pharmaceutical industry of industrial nations, have the capital and advanced technical knowledge needed to benefit from the wealth of genetic information that the biosphere can provide, and thus the incentive to preserve the resource base. In short: developing countries are long on biodiversity and short on technology and capital to use them, while industrial countries are long on capital and technology and short of biodiversity. There are, in effect, gains from trade to be realized. Markets can help realize these gains.

But trading is tricky: what is involved here is trading the rights to use environmental assets such as the right to emit carbon from burning fossil fuels. Giving up the right to use energy can mean trading the right to industrialize. An international organization that ensures market integrity and fairness by mediating borrowing and lending of rights to use the atmosphere could help solve this problem. An International Bank for Environmental Settlements (IBES) has been proposed for this purpose.¹⁴

¹⁴reference

5. The International Bank for Environmental Settlements

This section discusses the creation of a market based mechanism to encourage sustainable development: an international framework to regulate and monitor the trading of the use of the planet's atmosphere—in particular the rights of emission of greenhouse gases—and the use of other environmental assets—such as the rights to use biodiversity. The framework proposed here aims to provide global solutions to environmental problems. Some of these problems are local or regional in nature (such as watershed functions), and others have a global nature (such as greenhouse gas emissions into the atmosphere). In all cases, however, the framework proposed will take a global approach to what has become a global problem requiring global solutions: finding and implementing sustainable development practices throughout the earth. A blueprint for such an institution was proposed by the author at the 1995 Annual Meetings of the World Bank in Washington D.C. under the title of **International Bank for Environmental Settlements (IBES)**.¹⁵

Trading emissions is an important part of the IBES but by no means the most important aspect of what is proposed. This IBES would help organize and act as an intermediary in several other areas, mentioned in the introduction.¹⁶ Some of

¹⁵The blueprint was published under the auspices of UNESCO and the UNDP in New York, September 1996. As already stated, the creation of such an international framework was agreed in the Third Convention of the Parties (COP3) of the United Nations Framework Convention for Climate Change (FCCC) in Kyoto, December 1-10, 1997. It is embodied in Article 6 of the Kyoto Protocol, paragraphs 1 and 5.

¹⁶:

The trading of rights on greenhouse gases emissions and biodiversity use

The trading of environmental bonds

The trading of rights on the use of the global airwaves

The trading of options and other derivatives based on the above

these functions are elaborated below.

6. Trading emissions: a global environmental asset

The first, and simpler, function of the IBES is to mediate and monitor the trading of rights to emit greenhouse gases. The system works as follows: a ceiling on world emissions and on each trader's emissions, is agreed as done in Kyoto COP3, for Annex I countries (industrial nations).¹⁷ If a country emits below its ceiling it can sell the excess rights to other nations. If a country exceeds its ceiling, it has to buy rights to emit from another. In all cases, however:

- The world always remains within the agreed emission ceilings.

and

- Whether a buyer or a seller, a nation always pays to emit, so the cost of emission increases. A trading system involves added costs for emission of greenhouse gases.

7. National, regional and global levels

Trading emission rights can be carried out at several levels. It can be done (1) among countries, (2) among countries and corporations, and (3) among countries,

The IBES could also:

Securitize profit sharing agreements on genetic blueprints

Securitize profitable investments in the sustainable use of aquifers, watersheds, biological soil enhancement, and fisheries, and

Provide bridge financing and credit enhancement facilities for all of the above.

¹⁷So far developing nations have not agreed on emission ceilings, as their emissions are and have been historically way below those of industrial nations, and sufficiently low that they do not pose a problem in themselves for the global climate.

corporations and individual traders. The more traders there are, the more liquid the market and the more chances it has to be truly competitive.

On the other hand, there is no need to adopt trading as a universal system. Trading could occur among nations, each of which ensures that they stay within the agreed limits by taxing their citizens or their industry. In other words: there can be a mixture of systems co-existing with each other. For example: a typical situation could involve a nation trading permits with others, and restricting carbon emissions within its borders to satisfy the level traded by means of taxes, or even by means of command and control measures.

8. Environmental taxes vs. permits

A tax on carbon emissions operates by charging a fixed rate per unit of carbon in each fuel purchased. This discourages the use of carbon and therefore decreases emissions, hopefully so as to reach a level that is acceptable within the existing standards. For example, a tax can be imposed on each unit of carbon dioxide which is generated by the use of a fuel (such as gasoline or coal) or by products which use fuel (such as a car, or a lawn mower). Taxes are somewhat imprecise in that the user decides whether they wish to pay more or emit less, and there are no hard limits imposed.

How do taxes differ from emissions trading systems? An emissions' trading system is like a tax in the sense that emitting always imposes additional costs, and the more one emits the more one has to pay. Therefore they discourage emissions. For example: if emitting beyond one's established emissions ceiling, one has to bear the costs of buying permits. The more one emits the more permits one has to buy and the higher will be the overall cost. Furthermore even if staying below one's ceiling there is a cost to emitting. The cost is in this case the monetary loss

of not being able to sell the permits in the market; the more one emits the higher is the cost. Emitting always leads to additional costs, exactly as in a tax system. However, the analogies end there. The main differences between a permits system and a tax are:

- In trading permits, a hard quota system must always be imposed. Therefore emissions trading keeps the total of emissions always below the limit agreed. Emissions trading is more “exact” than taxes in limiting total emissions
- Permits prices are set by market supply and demand, while tax rates are set by governments
- Taxes are collected by governments who decides how to allocate the proceeds. They involve more government intervention.
- Permits are different: the income derived from trading permits goes to reward those who emit less, and is paid by those who emit more. It is in effect a way to redistribute income to reward investment in the future.

9. The dual role of the IBES: private and public

The IBES offers an international framework for assigning rights on a continuing fashion following the outcome of FCCC negotiations, and for organizing rules and modalities of the relationships among the parties, and monitoring compliance: this makes the IBES similar to an international organization such as the Bretton Woods institutions (the World Bank, the IMF, GATT, etc.). At the same time, the IBES offers market facilities, for example the trading of emissions rights in a global scale. While markets are often regulated, no international organization to date offers a market function. Furthermore no market in existence today

offers international organization functions such as multilateral policy making. *The IBES is therefore a novel type of institution, combining at once elements of private markets as well as public decision making.*

Although the global trading of emissions is an important landmark, indeed the first international emissions market to emerge in history, the concept of trading emissions rights is not new.¹⁸ Since the global emissions trading system was proposed by this author in 1993, markets for trading sulphur dioxide emerged in the US, and are traded today in the Chicago Board of Trade. As already mentioned, without establishing firm emissions ceilings, as those imposed by the Clean Air Act or those imposed in Kyoto by the COP3 for Annex I countries, emissions markets cannot function.¹⁹ This is why only industrial nations (Annex I countries) are involved today in trading permits within the Kyoto Protocol.

Emissions trading is tricky, since it limits the rights to use energy and therefore the right to industrialize. Developing nations are understandably suspicious of the scheme, and indeed are not part of the newly created emissions trading scheme agreed by the COP3 in Kyoto. Developing countries have taken the justifiable position that the bulk of the carbon emissions are generated in industrial nations, and therefore it is up to them to make this up by restricting their own emissions.

10. A win-win solution for industrial and developing nations

Despite the justifiable concerns of developing nations, the IBES can help satisfy the needs of developing nations as well as help realize the restrictions on emissions by industrial nations. In this sense it can provide a win-win solution, a solution

¹⁸ references

¹⁹ In the case of water, natural watersheds are known to be scarce and there is no need to set artificial limits on these.

that benefits both groups of nations. This section will explain why.

As already mentioned above, since the IBES is based on environmental markets it could also have an important role in ensuring *equitable patterns of distribution* of rights in the use, and the fair trading, of global environmental assets. Environmental markets (for example carbon emissions markets) are different from other markets in that they trade *privately produced public goods* and as such require equitable patterns of property rights to ensure market efficiency.²⁰ This unique trait of environmental markets, which is not shared with standard private markets, breaks down a barrier between industrial and developing nations. It ensures that the goals of the two sets of nations are satisfied: efficiency in trading as desired by the industrial nations, and equity in the assignment of the global commons, as desired by the developing nations. Corresponding to this the IBES is a unique institution in that it has the two faces of a coin: a market aspect which is preferred by industrial nations to minimize cumbersome public intervention, and an international organization aspect in which nations are represented in major decisions on an ongoing basis. The IBES could provide the first of the institutional structures needed for the new global economy, offering a win-win solution for industrial and developing nations in the difficult and important problem of managing global climate change, and more generally of achieving human development that is harmonious with nature.

The IBES could offer not just trading of rights but also borrowing and lending of these rights. When combined with the ability that the IBES will have to use open market operations for setting discount rates (such as the Federal Reserve does in the US, and Central Banks do in many other nations) the IBES offers much more control to developing nations for achieving efficient and equitable

²⁰ reference

outcomes than a simple market could achieve. For the developing countries the IBES can offer the ability to control borrowing and lending rights, ensure fair treatment and an equitable share of the burden in restricting emissions, as well as an economic return from the preservation of forests and biodiversity. It can provide them capital for development without destroying their, and the planet's, environmental assets. For the industrial nations it can offer a market approach that minimizes government intervention and can bring the highest returns to private investment in the new environmental markets. More on this below.

11. Trading biodiversity rights

The IBES can go further in reaching its goals by organizing and ensuring the integrity of trading rights on biodiversity use, the use of global airwaves, and by securitizing profit sharing agreements on genetical blueprints. The following explains the concept of securitization and why it can be valuable in this context. It examines two examples: watersheds and genetical blueprints.

12. Securitization

The term *securitization* refers to the fact that the rights to an asset can be split into smaller pieces which are sold on their own, and become known as securities. For example: the profits of a corporation is an asset. Shares in the rights to the corporation's profits are pieces of the asset. They are called "stock," and they are characterized by the fact that the value of stock goes up and down with the value of the corporation. Bonds are also securities, and smaller pieces of a larger asset: the promise to pay interest on debt by the city of New York is an asset that is sold into smaller pieces, and the pieces are called New York bonds.

The smaller pieces are less expensive and easier to resale, and therefore more

accessible: as more investors can purchase them, and they are easier to sell, this gives more “liquidity” to the market.

A contract or a group of contracts is an asset. For example all the mortgages in the East Coast of the US, or all the rights to emit carbon dioxide in the world, or all the rights to sharing profits in the future services of a watershed, are contracts and therefore assets. These are larger assets on which a security can be created. Each security represents the rights to a piece of the larger contract. Stocks are securities that share the value of the underlying property, and therefore represent risk sharing agreements. Bonds are securities that offer a fixed, agreed, stream of interest on debt, and ensure a final value at the end of the period.

Securitization offers special advantages when dealing with large groups of assets at one time. When securitizing a large group of contracts, for example mortgages in the East Coast of the US, each contract has a risk profile and pays a corresponding premium (for example, 8.5% in the case of mortgage interest). But the entire group of contracts has a lower risk profile due to the law of large numbers. Yet the premium remains the same, 8.5%. Buying smaller pieces of the group of contracts produces therefore a net gain to the investor, since the contracts pay higher interest than is appropriate for the reduced risk involved. The net gain can be split between the investor and the user of the mortgage (by decreasing the interest to the homeowner), and both parties end up better off than before. This win-win solution is simply knowledge about the law of large numbers applied to financial markets.

13. Watersheds and genetical blueprints

Using the principle of securitization one can take a large asset, such as the water services provided by the watershed for the City of New York in the Catskills,

or by the watershed for the cities of Sao Paulo and Rio de Janeiro in the Mata Atlantica, Brazil, and produce securities (bonds or stocks) that are sold to the public. These securities can be stocks or bonds. In the latter case they are often called environmental bonds.

The securities called "stock" differ from bonds in that they share risks, namely the potential gains and losses from the business venture. Buying IBM stock means sharing the risks that IBM corporation will increase in value. In the watershed case, the investors share the potential gains to be made by creating a corporation who owns the rights or part of the rights to the profits involved in developing a genetical blueprint. Merck entered into such a deal with INBIO, a government-owned research institution in Costa Rica: they share with INBIO the gains from bioprospecting in the Costa Rican's forests in an agreed upon formula, see Chichilnisky (1995). Shaman pharmaceuticals made similar deals with localities in Brazil and Argentina, and has already obtained FDA approval for the marketing of a medication obtained by following expert advise of a "shaman" or "medicine person."

In the watershed example what is at stake are the savings involved in investing in the conservation of the watershed. For example, buying land around in the watershed to prevent real estate development from decreasing its ability to purify water, rather than building a (much more expensive) purification plant. The savings that the watershed can provide when compared with the costs involved in providing an artificial filtration plant to provide the same services, can run in the billions. These savings are shared with the holders of the securities. A deal of this nature was achieved in New York State last year, involving the sale of environmental bonds to purchase land in order to protect the Catskills watershed. Through the securitization scheme many private investors can purchase smaller

pieces of these gains, thus sharing the fate of the corporation involved in the conservation-cum-profit-making venture.²¹ It also makes private capital available to fund the venture itself.

14. Global solutions for local and global environmental problems

I have already pointed out the wide variety of services that the IBES can provide, for example by organizing the trading of carbon emissions permits to conserve the gaseous concentration of the planet's atmosphere, as well as by offering securities to raise private capital that can be used for conserving watersheds. These two examples are limiting cases of what is a wide spectrum of environmental assets that need to be conserved in order to achieve sustainable economic development. It seems useful to explain why a global institution can serve a purpose in such a wide variety of cases.

Since carbon dioxide distributes uniformly, the atmosphere composition is one and the same for all: this is therefore a global asset. Watersheds serve limited areas, and the fate of one watershed does not affect the fate of others: they are local or regional assets. Yet it is important to realize that the IBES can offer a unique service because of its global scope, even when the environmental assets themselves are local in nature. This is because of the law of large numbers and its effect on risk distribution, something that has already been pointed out above.

For example: in securitizing all watersheds in the Americas, or even all watersheds in the world, the risk profile of the security (sharing profits in the watershed services) decreases by the law of large numbers, and therefore the investment becomes more attractive to the private investor. This attracts needed capital for this

²¹This is developed in detail in "Securitizing the Biosphere" by G. Chichilnisky and G. Heal *Nature*, 1998.

conservation-cum-profit venture. Securitizing all watersheds at once has therefore a unique benefit that is not available to one project at the time, and the IBES's global presence and profile can take advantage of this opportunity for everyone's benefit.

An issue that has been raised on several occasions is the business justification for providing more efficient water services in a relatively populous but poor country. In short: who pays for the Mata Atlantica's watershed project?

The Mata Atlantica watershed collects and purifies water for tens of millions of people in the vicinity of Sao Paulo and Rio de Janeiro, Brazil. In addition, Mata Atlantica contains some of the most valuable and unique biodiversity in the world. The conservation value is clear. But what about the economic value of the project?

In a democratic country such as Brazil, which is one of the largest economies in the world, the main cities must be provided with water facilities in order for a candidate from that area to succeed in local or national elections. The political incentive to provide water services is clear, either natural services by conserving the watershed or through new and more expensive artificial filtration plants. The added costs of building artificial filtration is often paid from foreign borrowing, but eventually the national debt is paid by the taxpayer. If conserving the Mata Atlantica means substantial savings over the alternatives, as it was demonstrated in the case of New York water, the taxpayer undoubtedly gains. If these gains are properly securitized they can raise initial funding for the project, and eventually both the taxpayer and the investor can share the benefits of conserving the watershed.

15. Conclusions

Following a fifty year period of unprecedented use of natural resources by industrial nations, the increasing scarcity of environmental assets highlights their value for economic progress. Yet economic systems are “stacked up” against conservation, often encouraging environmental destruction for short term gain. Economic science must be realigned with a new value system. This paper proposes a range of financial instruments for re-aligning these values, bringing future value of environmental assets into the present, and producing private incentives that lead to economic return while encouraging the conservation of these assets. A new type of institution, the International Bank for Environmental Settlements (IBES) was proposed by the author to accomplish this aim, and in particular to organize and monitor the global trading of greenhouse gases emissions and other financial instruments designed for the conservation of watersheds worldwide. Because it trades “privately produced public goods,” the IBES has to accomplish a more balanced and equitable distribution of resources in order to achieve global efficiency. In Kyoto, December 1997, the Third Convention of the Parties (COP3) of the United Nations Framework Convention for Climate Change agreed, in its Article 6, on the creation of such an international framework for trading emissions among Annex I countries. However the rules, modalities and enforcement mechanisms have not been fully determined. These will be determined in the next COP4, in Buenos Aires, November 1998. The functionality of the IBES exceeds in many ways the trading of carbon emissions, and makes it a unique global institution that is a combination of a market and a multilateral organization. It thus differs from all international organizations existing today. Yet it provides a global infrastructure that is needed more than ever in the increasingly globalized world economy, in a period in which the United Nations organizations are under

attack because of their heavy dependence on taxes and voluntary contributions. The IBES is new in that it will provide global infrastructure services, and charge on a fee for service basis.

An explicit consideration within the global negotiations of the IBES' multifaceted role, and of its mission in bringing a balanced and equitable share of the burden of abatement across nations, will make the emissions trading scheme more attractive to developing nations which so far have not agreed to be part of this trading framework. It can provide a win-win situation to industrial and developing nations in resolving the problems associated with greenhouse gas emissions, and more generally in finding sustainable and equitable paths of human development.