The Greening of Markets

Financial markets can play a valuable role in addressing climate change

Paul Mills

IT IS not immediately obvious what role financial markets can play in addressing climate change. Climate change happens slowly and has a global impact on the physical environment, whereas financial markets react to news in fractions of a second and are almost liberated from specific physical locations. The low energy intensity of the financial sector means that reductions in greenhouse gas (GHG) emissions would have little impact on the physical operations of financial markets and institutions (unlike, for instance, their effects on electricity production or transport).

Nevertheless, financial markets potentially play two important roles in the policy response to climate change (see table). First, they foster mitigation strategies—that is, the steps taken to reduce GHG emissions for a given level of economic activity—by improving the efficiency of schemes to price and reduce emissions (for example, carbon permit trading) and the allocation of capital to cleaner technologies and producers. Second, financial markets can cut the costs of adaptation—that is, how economies respond to climate change—by reallocating capital to newly productive sectors and regions and hedging weather-related risks.

In recent years, markets in carbon permit trading, weather derivatives, and catastrophe (CAT) bonds have seen sharp increases in activity and innovation, which bodes well for the future. But if a basic understanding of finance is not reflected in policy design, climate change policy can suffer setbacks. Hence, recognizing how financial markets will react to climate change initiatives, and how they can best promote mitigation and adaptation, will become crucial to shaping future policy and minimizing its costs.

Reducing GHG emissions

On the mitigation front, a large number of countries have committed, or are likely to commit, to targets to curb GHG emissions by 2012 under the Kyoto Protocol or its successor arrangement. In addition to regulatory restrictions, this policy goal can be achieved through either emissions taxes or schemes to cap emissions and allow trading of permits. In such an environment, financial markets can reinforce commercial pressures on firms to reduce emissions.

One such mechanism is the *"green" investment fund*. Originally part of the movement for "socially responsible" or "ethical" investment, such funds were established in the 1980s to invest only in companies working to limit the environmental damage they caused. Since then, more specialist funds have been launched that invest in companies, projects, and technologies involved in reducing GHG emissions. In fact, some recently launched equity indices comprise only shares of companies that have low GHG emissions or are investing in abatement technologies. The amounts invested in green funds are as yet too small to have a significant impact on overall equity performance. But if the post-Kyoto settlement results in a sig-

Identifying the right tools

Financial instruments can help minimize the costs of reducing greenhouse gas emissions and adapting to climate change.

Emissions trading	Climate change–related investments	Market for catastrophe and weather risks
Mitigation strategies		**Adaptation strategies**
Instruments		
Tradable emissions permits	Investment funds in sectors that could profit from climate change (for example, water and nuclear)	Catastrophe risk transfer instruments (for example, CAT bonds and swaps)
Futures and options on emissions permits	Investment funds dedicated to clean technologies	Weather and crop insurance
Funds investing in emission permits	Projects earning carbon credits	Derivatives for hedging weather risk
Intended effects		
Minimization of costs of given level of reduction of greenhouse gas emissions	Efficient reallocation of capital in response to climate change	Risk sharing of natural catastrophe and weather-related risks
	Provision of new capital for financing climate change mitigation	Maintenance of insurability of weather risks and reduction in premiums
		Provision of price signals of weather-related risks and costs

Source: Deutsche Bank (adapted).

nificant tax on, or price for, GHG emissions, then companies with low current emissions or investments in abatement technologies should outperform the market. Indeed, this already seems to have been anticipated by equity investors. When launched in October 2007, the 300 stocks comprising the HSBC Global Climate Change Index had outperformed the MSCI World Index by 70 percent since 2004.

More generally, as GHG emissions are taxed or rationed, to the extent that companies are unable fully to pass on these costs, the cost of capital for heavy emitters will suffer relative to their competitors. Such price signals will reallocate capacity to sectors and regions in which production, investment, and research are most profitable, given a higher price for emitting GHGs.

A second mechanism is the Kyoto Protocol's ***Clean Development Mechanism (CDM)***, which allows cheaper emissions reductions in emerging markets and low-income countries to be certified by the UN and then sold as credits to offset emissions in cap-and-trade schemes in high-income countries. Substantial funds have been raised to invest in projects to benefit from certified emissions reductions under the CDM. Credits worth €12 billion were sold into the European Union's Emissions Trading Scheme (ETS) in 2007, and funds dedicated to carbon reduction projects now exceed €10 billion. However, the CDM's effectiveness is limited by slow project accreditation and concerns about both project quality and whether they make any appreciable difference to GHG emissions growth in emerging economies.

A third mechanism—and the clearest example of a financial market playing a central role in climate change mitigation policy—is ***carbon emissions trading***. Following the precedent of the U.S. market for sulphur dioxide (SO_2) permits—which reduced SO_2 emissions at low cost—provision for permit trading was included in the Kyoto Protocol, and trading schemes have been developed in the European Union, Australia, and the United States.

Heavy EU trading

The European Union ETS is the largest such market, with €9.4 billion in EU allowances traded in 2005, €22.4 billion in 2006, and €28 billion in 2007. In volume terms, trading has grown considerably since 2005 (see Chart 1). The European Union ETS began in 2005 with a trial phase, and in early 2008 it moved into Phase II—which is designed to implement the European Union's Kyoto Treaty emissions reduction target from 2008 to 2012. Futures trading in EU allowances started in 2004, and futures and spot EU allowances are now traded on five exchanges and by seven brokers, concentrated in London. Weekly turnover has grown to more than 20 million tonnes of carbon dioxide (CO_2) equivalent, roughly 70 percent of which is traded through brokers. Liquidity has improved substantially, with instantaneous trades now possible at tight bid-offer spreads. Initially, energy companies were the primary market participants, but investment banks and hedge funds have also become active traders.

Such cap-and-trade schemes are intended to minimize the cost of a given level of pollution abatement by creating property rights to emit, administratively limiting the supply of permits to the target level, distributing permits (either by auction or by direct allocation), and allowing them to be traded so that emitters short of permits are forced to buy them from those that are "long" because of abatement. Theoretically, this should result in the marginal cost of abatement equaling the price of a permit within the scheme, with emissions being cut by the most cost-efficient producers—a result that is equivalent to an optimal GHG emissions tax (see "Paying for Climate Change" in this issue).

Has the European Union ETS proved successful? A liquid market for carbon has been created whose price has reflected changing market fundamentals. The significant price of emissions permits has generated some incentives toward abatement. Nevertheless, some lessons have been learned.

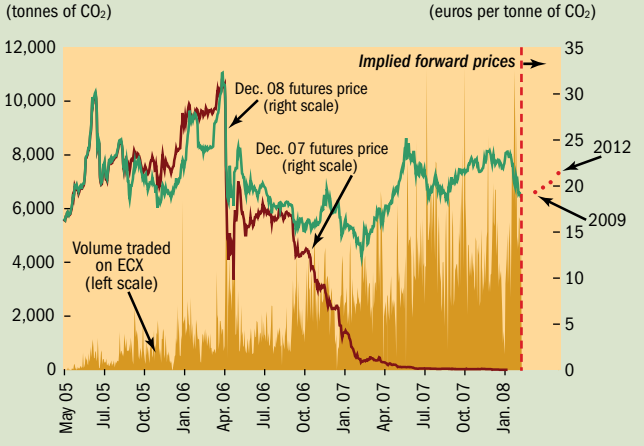
First, ***price volatility has been higher than necessary***. Most notably, permit prices in April 2006 dropped sharply because of rumors and selective publication of information by some EU members, indicating that permits had been overallocated in Phase I (see Chart 1). Subsequent confirmation that the scheme as a whole was net "long" resulted in the collapse of the Phase I price to close to zero. Allowing unused Phase I permits to be banked for use in Phase II would have limited price sensitivity and reduced reputational damage to the scheme. In addition, more frequent and careful release of market-sensitive data would have reduced unnecessary volatility and increased confidence in price reliability.

Second, ***so far the European Union ETS has fostered trading of EU allowances with little impact on long-term investment.*** When the price of EU allowances was at the higher end of its range, some energy companies reportedly switched marginal production from dirtier coal to cleaner, gas-fired power stations. Some producers also say that a significant price for carbon is encouraging energy-saving investment. However, attention has focused on buying credits from outside the EU scheme (principally from China), where abatement costs are substantially lower. In addition, Phase II of the scheme is insufficiently long lived to provide credible incentives for investment in cleaner energy technologies. Consequently, the fall in EU carbon intensity has slowed, despite the ETS, and recent performance has been worse than in the United States.

Chart 1

Active green trading

Carbon trading in the European Union has been growing, despite price volatility.



Source: European Climate Exchange (ECX).
Note: Data as of February 5, 2008.

> **"Perhaps the clearest way in which financial markets can help with adaptation to climate change is through the increased ability to trade and hedge weather-related risk."**

These lessons have prompted a comparison with the prerequisites for successful emissions trading and those for credible monetary policy. For a cap-and-trade scheme to develop long-term credibility, authority should be delegated to an independent central bank–type institution that is given a politically driven target to abate emissions at the lowest cost. This institution would be charged with the transparent and careful release of data, enforcement of long-term property rights, and discretion to change bankability and safety valve provisions to keep the price of permits within a set range to achieve its goal.

Adapting to climate change

On the adaptation front, financial markets can help to reduce the costs of climate change in several ways. First, markets should generate price signals to reallocate capital to newly productive sectors and regions. By shifting investment to sectors and countries with higher rates of return (for example, water and agricultural commodities), the costs of adaptation would be reduced below those that would arise from an inflexible capital stock.

For instance, climate change is likely to change the dispersion and intensity of rainfall, leading to greater conservation investment in newly arid regions and in crops that use less water. The recent outperformance of companies specializing in water purification and distribution suggests that such factors are beginning to be reflected in equity prices.

But perhaps the clearest way in which financial markets can help with adaptation to climate change is through the increased ability to trade and hedge weather-related risk, which, some meteorologists believe, will increase as a result of climate change.

Weather derivatives offer producers whose revenue is vulnerable to short-term fluctuations in

temperature or rainfall a way to hedge that exposure. Exchange-traded weather derivatives focus primarily on the number of days that are hotter or colder than the seasonal average within a defined future period. For instance, if there are more cold days than average over the contract period, those that have bought the "cooling degree day" future will enjoy a payout proportionate to the excess number of cold days. Futures enjoy low transaction costs and often relatively high liquidity. However, the parameter used to determine the futures contract payout may not be correlated exactly with a firm's actual losses if extreme weather occurs. Hence, trading such derivatives often provides only an approximate hedge for firms' weather-related exposures.

After a slow start in the late 1990s, the exchange-traded weather derivatives and insurance markets have grown strongly in recent years (see Chart 2), with a reported turnover of weather contracts exceeding $19 billion in 2006–07, from $4–5 billion in 2001–04. Exchange-traded contracts have focused primarily on short-term trading of temperature in selected U.S. and European cities, with liquidity now concentrating in near-term contracts as hedge funds and investment banks take a larger share of turnover.

Weather derivatives are complemented by weather swaps and insurance contracts that hedge adverse weather and agricultural outcomes. For instance, insurance contracts are being sold that pay out if temperature or rainfall in a specified area exceeds the seasonal average by a sufficient margin. Governments in some lower-income countries (for example, India and Mongolia) are offering crop and livestock insurance as a way to protect their most vulnerable farmers. Ethiopia pioneered drought insurance in 2006.

Governments can assist in developing weather derivatives and insurance by providing reliable and independent data on weather patterns. These data enable market participants to model weather risk at a particular location with greater accuracy and so offer a lower price for insurance. Similarly, neutral tax, legal recognition, and regulatory treatment of weather derivatives and insurance are necessary to ensure that artificial barriers to the market do not arise unintentionally.

Given that climate change is predicted to produce more extreme weather events, ***CAT bonds*** offer a new way for financial markets to disperse catastrophic weather risk (Hofman, 2007). At their simplest, CAT bonds entail the proceeds of the bond issue being held in an escrow account and surrendered to the issuer if a parameter(s) measuring an extreme natural catastrophe, such as a hurricane or an earthquake, breaches a specified trigger level. For this insurance, bond investors are paid a yield premium, and the principal is returned if the trigger is not breached by the time the bond matures.

The results are potentially profound for the continuing supply (or extension) of weather catastrophe insurance and the protection of vulnerable sectors, such as agriculture and coastal property. They offer insurers many more flexible ways to access the global capital markets to undertake catastrophe risk, thus allowing insurance to continue to be provided despite climate change.

CAT bonds were devised in the early 1990s, following the large payouts resulting from Hurricane Andrew in 1992, to enable reinsurance companies to divest themselves of extreme CAT risk and economize on capital. Until 2005, CAT bond issuance was less than $2 billion a year. But after Hurricane Katrina depleted industry capital, issuance has risen dramatically, with $4.9 billion in 2006 and $7.7 billion in 2007 (see Chart 3). Demand for CAT bonds has been strong from hedge funds and institutional investors looking for higher yields uncorrelated with other bond markets.

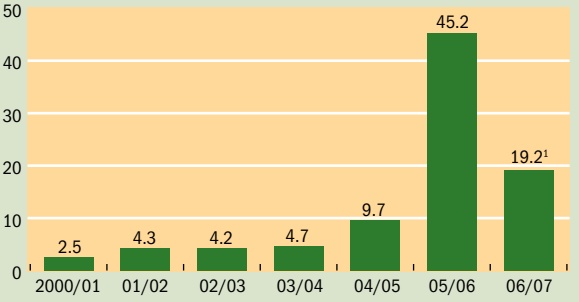
Although CAT bonds and other innovative ways of raising capital for weather-related reinsurance constitute only about 10–15 percent of global reinsurance capacity for extreme weather risk, their establishment as a global asset class should ensure that, if weather catastrophes do deplete the capital of the reinsurance industry in the future, it can be replenished

Chart 2

Blowing hot and cold

The demand to trade contracts providing protection against excessive temperature and rainfall has grown considerably.

(weather derivatives: notional value traded, billion dollars)



Source: PricewaterhouseCoopers.

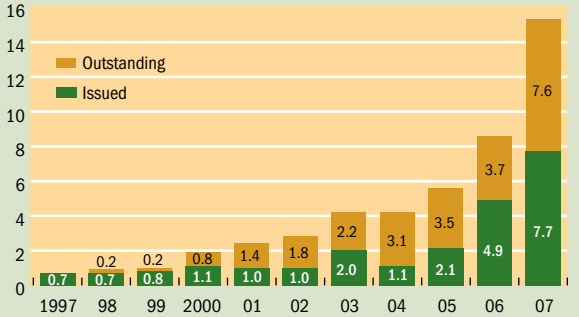
[1]Reduction in notional value traded in 2006/07 is largely the result of a move to monthly, rather than seasonal, contracts on the Chicago Mercantile Exchange.

Chart 3

Weathering the storms

Demand for catastrophe (CAT) bonds has accelerated in recent years as investors search for risks that aren't correlated with other financial markets.

(catastrophe bond issuance and amounts outstanding, billion dollars)



Source: Swiss Re Capital Markets.

more rapidly through the global capital markets. Premiums for weather risk insurance are already more stable following extreme weather events, and future insurability should be maintained at a reasonable cost, even if climate change results in their greater intensity.

How can governments respond to maintain insurability of weather-related risks despite climate change? First, authorities can restrict development in areas vulnerable to flooding or wind damage. Second, they can invest in flood defenses or water conservation measures to help private insurers continue to provide flood or drought coverage at a reasonable cost. Third, governments should refrain from subsidizing or capping flood or hurricane insurance premiums, because doing so encourages risky behavior and prevents the private insurance market from generating price signals to smooth adaptation to climate change. Higher premiums, or the withdrawal of insurance coverage, will provide incentives to curtail risky behavior and exposure to extreme weather. Permitting vulnerable property developments can make weather catastrophes an unnecessarily large fiscal threat—perhaps even for high-income countries.

Governments could consider hedging their fiscal exposures to catastrophes by directly issuing CAT bonds (as Mexico did in 2006 to provide earthquake insurance) or by participating in collective schemes to pool their weather-related risks, such as of hurricanes (as 16 Caribbean countries did in conjunction with the World Bank in 2007 through the Caribbean Risk Insurance Facility—a $120 million regional disaster insurance facility).

Demand for new CAT risks for diversification is exceptionally strong in the CAT bond market at present, so the insurance offered for new risks should be of relatively good value. Rating agencies could consider raising the credit ratings of low-income sovereign borrowers vulnerable to weather-related catastrophes if they cap their extreme fiscal risks through insurance. As with weather derivatives, providing longer runs of reliable and independent weather data enables insurance modelers to project weather patterns with greater confidence, thereby reducing the cost.

Benefiting from innovations

It seems likely that financial markets will play an integral role in climate change mitigation and adaptation in the future. Securities markets will reward those companies that successfully develop or adopt cleaner technologies. Cap-and-trade seems to be becoming the mitigation policy of choice in high-income countries, in which case the global market in permits for GHG emissions is likely to become the largest global commodity market.

Although weather derivatives and CAT bonds do not offer a complete panacea—as yet, only hedges against weather and catastrophe risks are available out to five years—recent rapid innovation and deepening in these markets prompt optimism that they will continue to innovate and further help adaptation to climate change. The growth of hedge funds and the appetite for risks that are uncorrelated with other financial markets mean that there is likely to be continuing demand for financial instruments that provide investors a premium to assume weather risk despite climate change. The ingredients for innovation exist, and governments should consider ways in which they can foster and take advantage of such innovations. ■

Paul Mills is a Senior Economist in the IMF's Monetary and Capital Markets Department.

Reference:

Hofman, David, 2007, "Time to Master Disaster," Finance and Development, *Vol. 44 (March), pp. 42–45.*

Statement of Ownership, Management, and Circulation required by 39 USC 3685.

1. Title: *Finance & Development*. 2. Publication No. 123-250. 3. Date of filing: February 12, 2008. 4. Frequency: Quarterly. 5. Number of issues published annually: four. 6. Annual subscription price: NA. 7/8. Complete mailing address of known office of publication/publisher: *Finance & Development*, International Monetary Fund, 700 19th Street, N.W., Washington, DC 20431. 9. Full names and complete mailing address of the headquarters of general business offices of the publisher and editor: International Monetary Fund, Washington, DC 20431; Editor-in-Chief: Laura Wallace, same address.
10. Owner: International Monetary Fund, 700 19th Street, N.W., Washington, DC 20431. 11. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of the total amount of bonds, mortgages, or other securities: None. 12. Tax status: has not changed during preceding 12 months. 13. Publication title: *Finance & Development.* 14. Issue date for circulation data below: December 2007.

15. Extent and nature of circulation	Average no. of copies each issue in preceding 12 months	Actual no. of copies of single issue published nearest to filing date (December 2007)
A. Total number of copies	50,475	50,800
B. Legitimate paid and/or requested distribution	6,196	6,208
C. Total paid and/or requested Circulation	6,196	6,208
D. Nonrequested copies	9,810	9,659
E. Nonrequested copies distributed through the USPS by other classes of mail	625	632
F. Nonrequested copies distributed outside the mail	30,238	29,918
G.Total nonrequested distribution (sum of D, E, and F)	40,672	40,209
H.Total distribution (sum of C, D, E, and F)	46,868	46,417
I. Copies not distributed	3,607	4,383
J. Total (sum of H and I)	50,475	50,800
Percent paid and/or requested circulation	13.22	13.37

I certify that the statements made by me above are correct and complete.
Laura Wallace, Editor-in-Chief