Stanford University • May 2009

SIEPR policy brief

Stanford Institute for Economic Policy Research

on the web: http://siepr.stanford.edu

Making Carbon Markets Work

By Paul Milgrom

Introduction

The United States is at long last preparing to take action on the problem of carbon emissions that lead to climate change. Among the leading proposals are ones that call for a cap-and-trade system to limit overall emissions to targeted levels while using market incentives to economize on the cost of the reduction. Market-based proposals have much to recommend them, but our experience from spectrum auctions, electricity auctions, and many other markets teaches us that implementation details are also critical. If the details are gotten wrong, the costs of achieving emissions reductions will be far higher than necessary.

Key to implementing a market-guided emissions reduction program is for the legislation to leave sufficient flexibility for private parties to advance policy goals in what they believe to be the most effective, lowest-cost ways. This principle appears to be most widely understood as it applies to emissions reduction technologies, but the same principle also applies to the timing of emissions reductions and to the operation of markets for emissions permits.

Markets play an important role in guiding firms' investment

continued on inside...

About The Authors

Paul Milgrom is the Shirley R. and Leonard W. Ely Jr. Professor in Humanities and Sciences. He is also co director of the Program on Market Design at SIEPR, which supports research into the ways that the rules of an auction, exchange, or other market affect its performance. He is a member of the National Academy of Sciences, a fellow of the American Academy of Arts and Sciences, the holder of an honorary doctorate from the Stockholm School of Economics, and winner of the 2008 Nemmers Prize in economics.

decisions concerning how to reduce emissions. For example, when a company considers building a new plant or evaluates alternative technologies with different amounts of emissions, its choice depends on its estimate of the future cost of permits. That is why *futures* prices for emissions permits are so significant: They provide informed, consensus estimates of future costs and give firms a uniform basis for making decisions, reducing the expected cost to the economy of emissions reductions.

Since the prices of carbon-emissions permits are so central to guiding decisions, it is important to keep the market for permits from being manipulated. There is ample historical evidence that markets for *essential* inputs like emissions permits can be particularly vulnerable to manipulation. Getting the market design right involves understanding the nature of the scarce resource that the market allocates.

The buildup of carbon in the Earth's atmosphere has taken place over a long period. Since the half-life of CO_2 in the atmosphere is several hundred years, the time pattern of carbon emissions during even a 20-year period is far less important than the total emissions over that period. A discounted time-shifting policy that allows a one-year acceleration of 95 tons of emissions in exchange for a 100-ton reduction next year is a good deal for the environment because it reduces total two-year emissions.

This "discounted time-shifting" policy has several advantages. First, as a threshold issue, this policy is not a loophole for polluters: Even if firms were to exploit this opportunity consistently, the policy would not lead to higher total carbon emissions over a 20-year period. Second, the policy avoids the inflexibility of rigid, time-dated goals that can lead to the adoption of inferior technologies. And third, the policy makes it drastically harder for a trader to profit by manipulating the carbon permits markets. That, in turn, obviates the need for restrictive regulations that severely limit trading in emissions permits.

The Discounted Time-Shifting Policy Reduces Total Carbon Emissions

The *discounted time-shifting* policy is structured to ensure that, even if the opportunity to accelerate permits is exploited consistently for many years, that would not increase total emissions over any period of 20 years or longer. This contrasts with the proposal in the Waxman-Markey bill, in which a rolling compliance period effectively allows undiscounted borrowing and a permanent addition to the stock of atmospheric carbon.

We explain the arithmetic of discounted time shifting with an example, in which the first emissions permits apply for year 2012 and permits for any year can be banked for use in later years. Suppose that 100 units of carbon emissions permits are consistently accelerated every year for 20 years, using our proposed 95 percent

Table 1

	No Trading	Trading With Discount	Trading Without Discount
2012	100	195	200
2013 – 2032	100	95	100
Total 2012 – 2031	2,000	2,000	2,100
Beyond 2032	100	95	100

conversion ratio. Table 1 illustrates the calculation.

The acceleration results in permitted emissions for year 2012 of 195 units, using 100 permits for 2012 plus 95 permits converted from 2013. For each of the years 2013-2031, accelerating 100 permits from the following year allows 95 units of emissions. Over the 20-year period, 2012-2031, the total emissions are therefore 195+19x95=2000, the same as if no time shifting had been done. If the acceleration continues after that, then the converted permits allow annual emissions of just 95 per year instead of the original 100 per year: The environment wins. And if the acceleration stops, then there is a reduction of 100 permits for year 2032: The environment wins.

The important point is that *any use of the discounted time-shifting policy always results in a long-term reduction in carbon emissions and a clear win for the environment, reducing total emissions over the 20-year time horizons.* Time shifting without discounting as in the Waxman-Markey bill does not share this advantage.

The Discounted Time-Shifting Policy Enhances the Efficiency of Carbon Reductions

The time-shifting policy can have a salutary effect on firms' decisions about how to reduce emissions. For example, suppose that controls are put in place in 2012 and that better technologies for reducing emissions are becoming available over time. Suppose that a firm is deciding between two plans — A or B — to change its equipment, but with differing time patterns of reduction in emissions. Plan A reduces emissions by 10 units more than Plan B in year 2012, but in 2013 Plan B results in 15 more units of reduction than Plan A.

Since the relevant policy goal is to reduce total carbon emissions over a period of years, reducing emissions by 15 extra units in 2013 is better than reducing emissions by 10 extra units in 2012, so we would want the firm to choose Plan B. But without time shifting, the market prices might provide the wrong incentive. If initial reductions are difficult or if a speculator successfully manipulates the market price, a permit for 2012 might cost much more than one for 2013. A firm relying on the market price would find it more profitable to adopt the socially inferior alternative, which is Plan A.

With a discounted time-shifting policy, this counterproductive pricing pattern would be eliminated by arbitrage. For if the market price of a 2013 permit were less than 95 percent of the price of a 2012 permit, an

investor could make a profit by buying 100 year 2013 permits to convert and sell as 95 year 2012 permits. And since year 2012 permits can be banked to be applied to the same emissions as a year 2013 permit, the price of the 2012 permit cannot be lower than that of a 2013 permit. This near equalization of prices for the two differently dated permits encourages efficient emissions reduction decisions.

The Discounted Time-Shifting Policy Prevents Market Manipulation and Minimizes the Need for Damaging Restrictions on Permit Trading

Restricting time shifting raises the very real possibility that markets may become more vulnerable to manipulation. If the U.S. economy booms in 2012 and carbon emissions permits become scarce, a speculator could buy up a large quantity of permits and hold out for a very high price. This problem could emerge quickly: News reports suggest that price manipulation is already a problem in European emissions markets.[1]

The danger of manipulation is anticipated and addressed in different ways in the several current legislative proposals. For example, the Waxman-Markey bill provides for strict oversight and regulation of the new carbon markets, while the van Hollen bill would restrict the sale of permits in auctions to "covered entities" — which are essentially fuel producers and importers — and would impose limits on the numbers of permits that these covered entities can acquire or hold. Both of these types of restrictions can interfere with markets and make prices less useful for guiding decisions about reducing carbon emissions.

As I have explained above, for the prices of permits to play their proper role in guiding efficient decisions, it is important that there be both spot *and futures* markets that establish a consensus about future prices and costs. Investors who create these futures markets need to be able to cover their futures obligations, and the easiest way to do that is to buy permits in the government auction. Regulations that prohibit investors from bidding in the government auction can damage the futures market and make market prices less useful for guiding decisions about emissions reductions. Moreover, if the emissions market is improperly structured, it will be fragile, requiring regulators to make difficult judgments about the numbers of permits that various firms should be allowed to acquire. A far better approach begins by making the market much less fragile and therefore less vulnerable to manipulations, especially when regulation is difficult.

Markets for necessary inputs are most fragile at times when delaying purchases or buying substitute inputs is not an option for the buyers. This period of time — which I call the *danger zone* — can be

continued on flap...

1 "Evidence that Speculators are Moving the EU Carbon Price," Reuters April 29, 2009.

illustrated by the crisis in the California electricity market in 2000-2001, when unwise regulations required California utilities to buy most of their power in spot electricity markets. These regulations enabled firms such as Enron and Reliant Energy to create artificial shortages by various means, including turning off power plants at hours of peak demand purportedly "for maintenance." The result was power outages, astronomical spot power prices, the bankruptcy of Pacific Gas and Electric (PG&E), and huge financial losses for the state of California.

The discounted time-shifting policy eliminates the danger zone that would otherwise be present in the markets for emissions permits. Consider, for example, what might occur when the time has come to deliver permits to cover 2012 emissions. Suppose that the number of permits needed then is close to the total auction allotment. Without time shifting, emitters possessing too few permits to cover their emissions would be forced to buy additional permits at market prices. With no substitutes available, that creates a danger zone, in which manipulators may be able to drive up the price and earn a huge profit. Proposals to cap price increases to, say, 100 percent still leave huge profits for manipulators. But with discounted time shifting, an emitter is protected from the manipulator's extortion, because it can substitute 100 permits dated 2013 for 95 permits dated 2012. Indeed, the possibility of arbitrage prevents the market price of a 2013 permit from being less than 95 percent or more than 100 percent of the market price of a 2012 permit. Because arbitrage sharply limits the ability of any hoarder or manipulator to affect the market price of a 2012 permit and creates a high-volume substitute for a necessary input, regulations can permit investors to take much larger positions without creating the danger of market manipulation. Eliminating the danger zone in this way facilitates a more relaxed approach to regulating the carbon permits auction and the associated secondary market.

Conclusion

Discounted time shifting is a policy to allow firms, at their own initiative, to convert permits to emit 100 tons of carbon in or after year X into permits to emit 95 tons in or after year X–1. This policy has important advantages. First, it does no environmental harm: Even if firms accelerate permits to the maximum extent allowed, the policy results in less emissions over any 20-year horizon than the policy without acceleration. And over longer periods, it does even better. Second, it adjusts the relative prices of permits for different years in ways that encourage efficient decision making by firms. And third, it eliminates the danger zone of market manipulation, creating a substitute for year X permits that makes it difficult for hoarders or manipulators to have any substantial influence on market prices.

SIEPR

About SIEPR

The Stanford Institute for Economic Policy Research (SIEPR) conducts research on important economic policy issues facing the United States and other countries. SIEPR's goal is to inform policymakers and to influence their decisions with long-term policy solutions.

Policy Briefs

SIEPR Policy Briefs are meant to inform and summarize important research by SIEPR faculty. Selecting a different economic topic each month, SIEPR will bring you up-to-date information and analysis on the issues involved.

SIEPR Policy Briefs reflect the views of the author. SIEPR is a non-partisan institute and does not take a stand on any issue.

For Additional Copies

Please see SIEPR website at *http://SIEPR.stanford.edu.*

SIEPR *policy brief*

A publication of the
Stanford Institute for Economic Policy Research
Stanford University
579 Serra Mall at Galvez Street
Stanford, CA 94305
MC 6015

Non-Profit Org.
U.S. Postage
PAID
Palo Alto, CA
Permit No. 28