Comments on "Prices, Quantities and Innovation"

By Charles D. Kolstad

V. Kerry Smith

June 1, 2010

If we could rely on technological innovation to dramatically reduce the costs of mitigating greenhouse gases, climate policy would be easy. All the analyses of the design and impacts of climate policy can agree with this point. Nordhaus [2008], for example, finds the present value of abatement costs would be about one-fourth that of his optimal approach if we could assume a low cost backstop technology was available to replace fossil fuels when carbon's price reached $5 a ton (in 2005 dollars). The Stern [2006] report makes exceptionally optimistic assumptions about technological advance, assuming abatement costs will decline by six fold by 2050. Thus, the focus of Charles Kolstad's paper is especially important. He notes that serious theoretical analysis to understand the effects of different climate policies on technical change needs to "unpack" the internal structure of the innovation process. He examines the interactions between three parties – the regulator, the firm facing environmental regulation and needing to control its emissions, and the firm offering new abatement technologies to reduce incremental abatement costs. In a stylized model that abstracts from uncertainty and the effects of regulatory policy in output markets, he finds that price and quantity instruments for regulating pollution can be made equivalent in terms of realizing the first best (efficient) amount of abatement and innovation. However, the total return to innovation is not the same and the distribution of returns between the polluting firm and the innovating firm are different. Innovators appropriate all the gains from innovation with a quantity standard and share the gains with a price instrument.

Kolstad's recognition of the importance of the internal process of innovative activities is to be applauded. As with all good research, it helps to answer some questions and frames new ones. I consider three questions here: Does past experience with other pollution control policy suggest we should be optimistic about technical change reducing abatement costs? Is Kolstad's single pollutant focus limiting? and What lessons from other analyses of innovation are relevant for climate policy?

Past Experience

The signature example of an incentive based environmental policy is the SO_2 permit trading program. Glowing accounts of its success can be found in the mid-and late nineties. [1] It is difficult to disentangle all factors contributing to abatement costs and assess how much new innovations reduced control costs. Nonetheless, a simple comparison suggests that modest, not dramatic, unanticipated cost savings seems to be the most plausible conclusion that can be drawn from experience with this program. To arrive at this conclusion I extracted estimates of the long run incremental costs of controlling SO_2 that were expected for 2010 from Burtraw's [1998] summary of what was known before the program was implemented. He suggested that the ICF [1990] study probably offered the best picture of expectations prior to the implementation of the SO_2 trading program because it included a detailed characterization of the ultimate design for the rule. This study estimated long-run marginal costs of controlling SO_2 in 2010 would be $579 to $760 per ton (in 1995 dollars). Using the consumer price index to convert these estimates to 2009 dollars, they are between $820 and $1077 per ton.

[1] It is easy to get carried away with promises that technology will eliminate costs of pollution abatement. For example, Carol Browner, noted when she was EPA Administrator and was discussing the SO_2 program as EPA administrator that "During the 1990 debate on the acid rain program, industry initially projected the cost of gas emission allowance to be $1500 per ton of sulfur dioxide … Today these are selling for less than $100" (March 10, 1997).

The best estimates for the incremental control costs today would seem to be the spot price of SO_2 permits. Figure 1 reproduces a chart from Cantor Fitzgerald's trading records for the period 2003 to 2009. These results are in the dollars of the year of the exchange. There is not a smooth pattern. Spot prices for sulfur permits are, like other prices, influenced by a number of factors including expectations for what is to happen with other environmental policies.

Using mid-range of spot prices in the two years prior to the economic downturn and converting them to 2009 dollars yields about $635 a ton or 23% decline from the low end of the expectations for incremental costs estimated in 1990. This would be about a 1.3 percent decline each year over these twenty years, certainly not negligible gains from unrecognized technologies, but also far short of the pace needed for a six fold decline in costs in forty-five years, as assumed in the Stern report.

Pollutants Don't Go Away

One of the earliest papers arguing that environmental externalities were pervasive, by Ayres and Kneese [1969], also emphasized the importance of an explicit recognition of materials and energy balances in modeling production and consumption. They argued we can change the form of pollution and where it is dispersed but the materials and heat comprising residuals do not "go away". In the end we must decide where they are to go. Kolstad's model focuses on reducing abatement costs without dealing with the disposition of what is abated. This issue never comes up in his model and I believe in further refinements it should. Innovation may create a new problem. For example, suppose we are able to reduce the costs of controlling airborne emissions by passing them thru a water mist instead of using a mechanical device. This innovation would create a "watery sludge" that captures the particles that would otherwise have been captured mechanically and removed as solid waste.

This point is important for several reasons. Changes in the regulations on a different pollutant – NO_x could influence the costs of controlling CO_2. As Burtraw and Szambelan [2009] suggest the interconnections between pollutants, reflecting Ayres and Kneese's warning to be sure economic analysis recognized the "physical realities" of production (and consumption), can be responsible for links between the markets for different tradeable pollution permits. A tangible example of such links, in the context of expectations about regulations, can be found in Figure 1. Court decisions about the implementation process for EPA's Clean Air Act Interstate Rule (CAIR) to control particulate matter and NOx caused dramatic moves in the SO_2 allowance price (the spike in December 2005 in the figure). In the U.S. climate policy is perhaps the most major source of uncertainty that can affect other environmental policies. This regulatory uncertainty has implications not only for controlling greenhouse gases, but potentially for the consistency of the signals that permit prices provide for innovations in the abatement all pollutants.

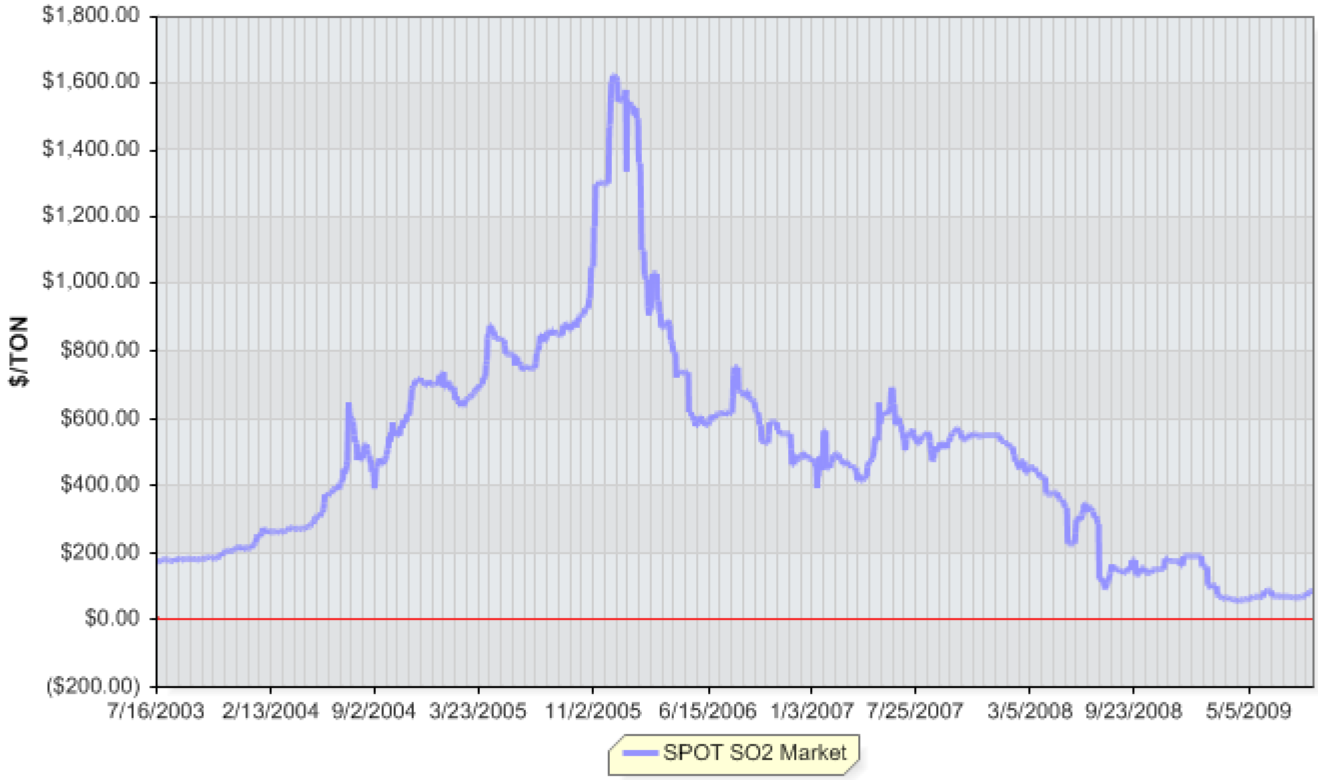
Lessons

At least two lessons from recent literature should be noted. First, Vernon Ruttan's [2006] last book argued that revolutionary departures from existing technological trajectories require new institutions. He was not optimistic that civil institutions could assemble the resources and create incentives that would lead to dramatic break throughs. Part of the reason for his relative pessimism was the inability of free societies to structure institutions that make these sustained commitments. In Kolstad's model commitments are given in the first stage of his regulatory game and remain consistent in his model. In the real world they change and may not be sufficiently consistent.

A more recent overview of innovation in different sectors reported in the Henderson and Newell (forthcoming) volume suggests competition and not government is the best guide for innovation policy. This conclusion may well be right for private goods and services – but what about non-market services. Markets do not provide signals for them. The prices from permits are a start – but there are few areas where such markets are in place and we need the innovations now. How do we avoid serious mistakes -

- creating with technological “cures” a set of problems that are worse than where we started. It is only by “unpacking” the details of the innovation process, as Kolstad has started, that we can hope to answer these questions.

Figure 1: Spot prices for SO_2 Permits[a]



a. Source: Cantor Fitzgerald website (accessed 5/21/2010)

REFERENCES

Ayres, Robert U. and Allen V. Kneese, 1969 "Production, Consumption, and Externalities " American Economic Review, Vol 59 (June): 282-297

Burtraw, Dallas, Sarah Jo Szambelan, 2009. "U. S. Emissions Trading Markets for SO_2 and NO_x " Discussion paper, RFF DP 09-40, Washington, D.C. Resources for the Future, October

Burtraw, Dallas, 1998. "Cost Savings, Market Performance, and Economic Benefits of the U. S. Acid Rain Program", Discussion paper RFF DP 98-28-REV, Washington, D.C. Resources for the Future, September

ICF Resources Incorporated (ICF). 1990. *Comparison of the Economic Impacts of the Acid Rain Provisions of the Senate Bill (S. 1630) and the House Bill (S. 1630),* prepared for U.S. Environment Protection Agency, Washington, D. C., July.

Kolstad, Charles D., 2010, "*Prices, Quantities and Innovations*" this volume.

Nordhaus, William, 2008, A Question of Balance (New Haven: Yale University Press).

Ruttan, Vernon W., 2006, Is War Necessary for Economic Growth (Oxford: Oxford Univ Press)

Stern, Nicholas, 2006, Stern Review on the Economics of Climate Change (London, UK: Her Majesty's Treasury).