

ENERGY INSTITUTE AT HAAS

RESEARCH *review*

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## Winners and Losers in the Emissions Permit Market

**Opponents of new environmental regulations often argue that they will raise the cost of doing business. With greenhouse gas (GHG) regulation on the horizon in the U.S., and already under way in the European Union, the question of the impacts of these regulations on industry has taken center stage. There is understandably great interest in how new GHG policies will impact the competitiveness, productivity, and profitability of the industries to which they are applied. Will GHG policies hurt all industries? Will GHG affect all industries equally?**

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In their paper, "Profiting from Pollution: An Event Study of the European Carbon Market" (EI @ Haas Working Paper 200), James Bushnell (Iowa State University), Howard Chong (University of California, Berkeley), and Erin Mansur (Yale University) study the impacts on firms of the largest, in monetary terms, cap-and-trade market in the world – the European Union's Emissions Trading System (ETS) for CO<sub>2</sub>. In 2006 the annual value of permits consumed in the European ETS market reached nearly \$60 billion. A market in the U.S. would be 2 to 3 times the size of the European market. These values are at least 10 times larger than any other previous emissions trading market and have generated intense interest in who will bear these costs.

Industries that claim to bear the brunt of the abatement costs usually ask for the largest allocation of permits. However, for most firms, changes in direct abatement costs are only one piece of a complicated profitability puzzle. The introduction of a price of CO<sub>2</sub> into an economy can have indirect impacts on firms that are not large emitters of CO<sub>2</sub>. In most industries, increases in CO<sub>2</sub> costs will be reflected in higher product prices, and therefore higher revenues, as well as costs. This revenue effect, however, depends on how a cost shock in an industry affects the product prices, which in turn depends on the elasticity of demand for the product, the relationship between a firm's emissions costs and overall costs, and the relative emissions of other firms. For example, industries that have little international trade exposure, use many dirty inputs, and produce substantial carbon emissions are more likely to have a strong revenue effect. A more complete picture of these net impacts is necessary in any attempt to align allocations to the true economic impacts of CO<sub>2</sub> regulation on firms.

Rather than attempting to directly untangle the many competing effects of the ETS on firms, the authors focus on the stock market valuations of publicly-traded

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# Are You Paying Too Much for Natural Gas?

**Efficient consumption of energy requires that the price reflect the true cost of consuming it. Yet, across the country, the per-unit charge for natural gas is substantially above the marginal cost of supplying it. In fact, even incorporating greenhouse gas emissions, current markups could only be justified if the price of CO<sub>2</sub> were \$170 per metric ton, considerably higher than the range envisioned by most policymakers. This artificially high per unit price may cause people to consume far less natural gas. Is there a better way to price natural gas while allowing firms full recovery of their costs?**

In many markets, marginal cost pricing arises naturally due to competition. However, natural gas distribution is a natural monopoly. It would not make sense, for example, to have two different sets of pipelines delivering natural gas on the same street. Natural gas distributors face large fixed costs of building and maintaining distribution networks, and marginal cost pricing typically does not provide enough revenue to allow firms to recuperate these fixed costs.

How regulators set prices for natural monopolies has been well studied by economists. A standard finding is that efficiency requires that prices should be set equal to marginal costs. Marginal cost pricing coordinates actions between buyers and sellers, ensuring that the efficient level of natural gas is used and allocating gas across buyers to its most productive uses. Fixed costs should then be recovered through fixed charges that do not vary with consumption. For natural gas, this would mean that much of the fixed costs of distribution networks would be recovered through monthly fees.

Lucas Davis, assistant professor at the University of California, Berkeley's Haas School of Business, and Erich Muehlegger, assistant professor of public policy at Harvard University, analyze the pricing of natural gas distribution market in their paper "Do Americans Consume Too Little Natural Gas? An Empirical Test of Marginal Cost Pricing" (CSEM Working Paper 194). They find that per unit charges for natural gas are substantially above marginal cost, so on the margin Americans are consuming too little natural gas. Their results are important in the discussion of proposed legislation that would place a tax on natural gas and other sources of carbon emissions because any such policy would further reduce consumption.

Although the efficiency rationale for marginal cost pricing is clear, there are two possible reasons why regulators may implement price schedules in which prices are marked up above marginal cost.

First, regulation creates a particular set of incentives for regulated firms. Under traditional rate-of-return regulation, firms receive a fixed rate of return on capital investments. If this rate is higher than the market rate of return, then the firm has an incentive to increase capital expenditures, and the easiest way for natural gas distributors to do this is to increase the number of customers. More customers mean more miles of network, more connections, and more metering equipment. And the best way to increase the number of customers is to charge low monthly fees. That way, even customers who want to use only a small amount of natural gas are persuaded to hook up. Consequently, regulated firms petition regulators to allow lower hook-up fees in exchange for higher per-unit markups.

Second, distributional considerations may lead regulators to set prices above marginal cost. When regulated prices are above marginal cost, high-volume customers cover a disproportionately large share of the fixed costs of operating the natural monopoly. Where monthly fees are exactly zero, for example, a customer consuming 100 units annually pays twice as much as a customer consuming 50 units. This structure is likely to have positive distributional consequences. To the extent that high-income households own larger homes and consume higher levels of natural gas, they will also pay a larger share of the fixed costs.

Examining the natural gas market from 1989 to 2008, Davis and Muehlegger find that price schedules differ substantially from marginal cost pricing. On average, customers pay markups of 36 percent above marginal cost. Pricing above marginal cost is prevalent in all 50 states and for all customer classes. Price schedules are particularly distorted for residential and commercial customers, who face markups that average 45 percent and 42 percent, respectively. (See Table 1 on Page 4.) Conservatively, these results imply that the current pricing system yields annual welfare losses of \$2.5 billion, compared to marginal cost pricing. In the United States total expenditure on natural gas in 2008 was \$92 billion so this represents approximately 3 percent of the total market.

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# Cap and Trade vs. Intensity Standards: Regulating Emissions in an Imperfect Market

**Under idealized assumptions, the preferred market-based environmental regulation is either to tax the pollution or to create an emissions market, such as cap-and-trade. But what if those idealized assumptions don't hold? For example, what if some competing firms in another country don't face the same environmental regulation? Or what if the market for the pollution-producing good is susceptible to market power? These conditions characterize many of our energy markets and should be considered when assessing the impact of a new emissions regulation.**

Stephen Holland, associate professor of economics at the University of North Carolina at Greensboro, investigates what the best regulatory policy should be in the presence of incomplete regulation and market power. In his paper "Taxes and Trading versus Intensity Standards: Second-Best Environmental Policies with Incomplete Regulation (Leakage) or Market Power" (CSEM Working Paper 190), Holland specifically analyzes whether another regulatory instrument – an intensity standard – can achieve a better outcome. This paper provides a framework for analyzing these policy instruments and suggests that an intensity standard should be considered when comparing environmental regulations.

Holland looks at two kinds of market failure with respect to environmental regulations: incomplete regulation and market power. Incomplete regulation can occur for two reasons. First, a political jurisdiction may not be geographically consistent with the region that suffers the environmental damage or with the product market. For example, since carbon is a global pollutant, regulating carbon emissions within any single state or country may cause production and emissions to "leak" to states or countries that do not regulate carbon emissions. Second, within a political jurisdiction not all sectors or industries may be treated equally so production and emissions can "leak" to the unregulated firms. Market power is also a real concern as many polluting industries sell their output in highly concentrated markets.

Market-based environmental regulations reduce emissions of firms through substitution among inputs and changes in output. Substitution effects reduce emissions by employing additional capital (e.g., emissions control technology) or more costly fuel inputs (e.g., switching to a cleaner fuel source). Output effects reduce emissions by reducing consumption of the polluting good (e.g., through carpooling or investments in energy efficiency). An intensity standard, which regulates the emissions rate per unit of output, is an inefficient mechanism for reducing emissions because it mainly induces a substitution effect but not an output effect. For example, the Low Carbon Fuel Standard encourages the use of cleaner fuels but does not directly encourage reduced overall usage of fuel, such as carpooling.

In a market with leakage or market power, however, an intensity standard may be better for reducing emissions because output effects may not adequately reduce emissions. With leakage, an emissions tax or cap increases production costs which may result in production moving out of the regulated sector to the unregulated sector. For instance, if carbon emissions are taxed in California, firms with carbon emissions may just move to Nevada and keep producing the same amount of output (and pollution). Similarly in markets with market power, firms already restrict output so a policy that additionally restricts output, e.g., a market-based environmental regulation, may increase abatement costs unnecessarily. An intensity standard may be better in either situation since it distorts output decisions less than either a tax or emissions cap.

With leakage, neither an emissions tax nor an intensity standard will generally attain the first best policy solution, so either may dominate the other. Holland shows that whether or not an intensity standard dominates is related to the stringency of regulation for the uncovered sector. For example, if the uncovered region (e.g., Nevada) is subject to its own reasonably strict environmental regulation, then an emissions tax dominates. However, if the uncovered region has lax environmental regulations, then an intensity standard dominates.

The importance of output effects in environmental regulation is shown by analyzing an intensity standard combined with a consumption tax. Holland shows that the combined policies can dominate a tax on the polluting input and sometimes can be efficient. For example, the efficiency of an intensity standard regulating the carbon emissions of electricity in California would be improved by combining the intensity standard with a tax on electricity. The advantage of the consumption tax is that it can be applied equally to all electricity consumed in California regardless of whether it is produced inside or outside the state, and thus does not create an incentive for production to leak outside California.

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**PAYING TOO MUCH?**

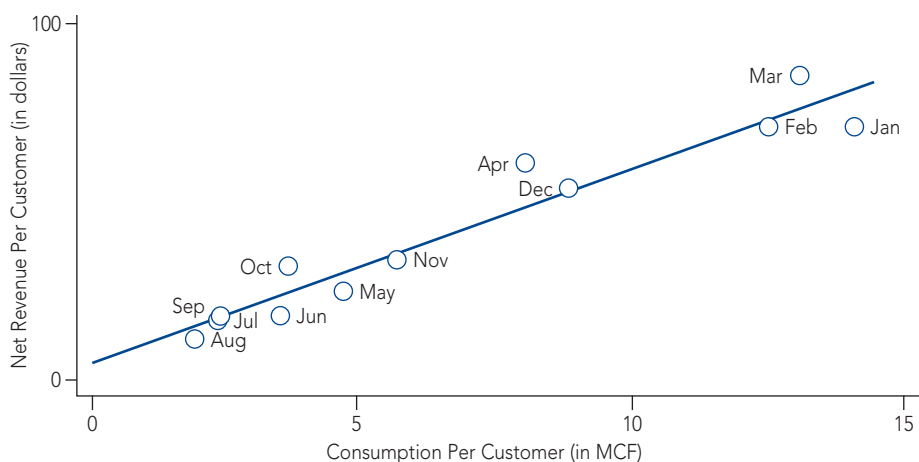
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**TABLE 1: AVERAGE DELIVERIES, REVENUES, AND MARKUPS BY CUSTOMER CLASS**

	<b>FRACTION OF TOTAL CORE LDC DELIVERIES</b>	<b>FRACTION OF TOTAL LDC NET REVENUES</b>	<b>PER-UNIT MARKUP OVER CITY GATE PRICE</b>	
Residential Customers	54.40%	74.90%	45.10%	\$3.16
			(0.7%)	(0.04)
Commercial Customers	27.50%	24.70%	42.10%	\$2.98
			(0.7%)	(0.05)
Industrial Customers	18.10%	0.50%	1.50%	\$0.20
			(4.1%)	(0.27)
All Customers, Pooled	100.00%	100.00%	36.40%	\$2.57
			(0.8%)	(0.05)

Note: The table reports averages across all available states for 2002-2007 for which data is available for all sectors, weighted by natural gas consumption in each state. Pooled markups are weighted by natural gas consumption for each customer class. Per-unit markups are normalized to year 2007 dollars. Deliveries to electric generators and non-core industrial and commercial customers excluded. Standard errors in parentheses are block bootstrap by state.

**FIGURE 1: RESIDENTIAL NATURAL GAS PRICE SCHEDULE FOR MASSACHUSETTS FOR 2006**



Of the available approaches for addressing these departures from marginal cost pricing, the most natural approach would be to have regulators increase the monthly fee and lower the price per unit. There is some precedent for this. For example, in May 2008, a new rate structure was approved for Duke Energy Ohio in which the monthly fixed delivery charge increased from \$4.50 to \$10.00 with an offsetting reduction in marginal prices. The Public Utilities Commission of Ohio argued that the rate structure is more equitable, "making sure that each customer pays only their share of the costs Duke must cover to deliver gas to their home."

Better aligning prices with costs sends the right price signal to both consumers and suppliers and doesn't create false incentives to overinvest in a distribution network. However, the transition to marginal cost pricing would have distributional consequences and it would be important for rate reform to be accompanied by targeted assistance for low-income households. There is broad experience with such needs-based programs which already exist in all 50 states.

In addition, by pricing natural gas above marginal cost, regulators create a situation where utilities recover the bulk of their revenues through the per unit charge. As an example, Figure 1 shows the relationship between natural gas consumption and utility revenues for Massachusetts in 2006. Note that the utilities receive roughly ten times more revenue from each customer during the winter months than they do in the summer months.

It is important to consider these existing markups when designing policies to address carbon emissions. Davis and Muehlegger show that the average markup of 36 percent is equivalent to a carbon tax of about \$170 per metric ton of carbon (\$46 per ton of carbon dioxide). This is considerably higher than the carbon tax envisioned by most policy makers. Therefore, if one believes that the external damages from carbon emissions are less than \$170 per ton of carbon, then customers are already facing a marginal price that is higher than the efficient price.



WINNERS AND LOSERS

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firms subject to CO<sub>2</sub> regulations. Specifically, they examine the impact of a sharp drop in CO<sub>2</sub> prices in late April 2006 on the share prices of affected firms. Previously, permit prices had experienced a great deal of volatility. The lack of reliable information about aggregate emissions was a critical contributor to the uncertainty about price levels. This changed on April 25, 2006 when the first reports of country level emissions data began to leak into the permit market. As can be seen in Figure 1, the reaction was dramatic. The paper focuses on the three days after the initial leak of permit market information. Even if one does not agree with an assumption that the market fully reflects expectations of future profitability, the event provides a useful window into the beliefs of the market about the impacts of the severe decline in CO<sub>2</sub> prices.

The story that emerges from an examination of this event is that the equity markets were strongly focused on revenue effects. In general, firms in industries that tended to be either carbon intensive or electricity intensive, but not involved in international trade, were hurt by the decline in permit prices. The study's results demonstrate fairly robustly that the share prices of firms from the "dirtiest" industries experienced the largest abnormal declines when the CO<sub>2</sub> permit price dropped so dramatically. Within the power sector, which was as a whole "short" of permits, the share prices of firms with the highest emissions rates perform better than the "cleaner" firms within this sector. The share prices of many of these high emissions firms did experience abnormal declines, but these declines were less severe than those of their low-carbon intensity competitors. The fact that very low-carbon emissions firms declined the most gives strong indication of the market's focus on how

FIGURE 1: EU CARBON PRICES, STOCK INDEX



declining CO<sub>2</sub> prices would reduce the revenues of these firms through lower electricity prices. The fact that high emissions firms still experienced declines indicates that the market also understood that these firms were holding large portfolios of allowances and experienced a loss in that portfolio that largely offset their cost savings from lower CO<sub>2</sub> prices.

These results are largely consistent with what simulation studies had predicted would be the case for many of these industries. Simulation studies forecast an increase in revenues that would largely offset the increase in regulatory costs. In fact, the event study analysis results imply that for (relatively) clean firms in dirty industries, the revenue effects are larger than cost increases. These are important facts to bear in mind when setting policies regarding allocations to affected industries. In many cases, those directly or indirectly affected by CO<sub>2</sub> costs may need little compensation, if any. Instead it is their customers who may bear the brunt of the increased costs.

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**CAP AND TRADE VS. INTENSITY STANDARDS**

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Holland also shows that an intensity standard is similar to output-based updating. Under output-based updating, emissions permits are freely allocated to firms based on their level of production. This regulation implicitly subsidizes output while taxing emissions as does an intensity standard. Output-based updating dominates an intensity standard because under output-based updating the implicit subsidy and tax can each be set optimally but with an intensity standard the implicit subsidy and tax are linked and so cannot be individually set at the appropriate levels.

With market power, the advantage of the intensity standard is that it implicitly subsidizes output while taxing emissions. This feature is an advantage because firms with market power have an incentive to restrict output. Under a simple monopoly scenario, Holland shows that the optimal intensity standard dominates the optimal emissions tax through higher output produced with fewer emissions.

Comparing environmental regulations requires modeling how markets are likely to respond to the proposed regulations. Such modeling invariably rests on simplified assumptions, but can still guide policy and point to needs for further investigation. Holland argues that incomplete regulation or market power can change the preferred market-based environmental regulation and can in some cases make intensity standards a less costly way to achieve environmental benefits.

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