Cap-and-Trade v. a Carbon Tax
Lessons Learned From the 1990 Clean Air Act

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Abstract

To reduce carbon emissions, Dr. William Nordhaus has proposed a $40/ton carbon tax that by 2020 will raise the price of gasoline by 42 cents and generate $200 billion in tax revenue. Called a "Pigovian tax," the theory behind this tax is to motivate polluters to raise prices as they internalize the tax, which will cause consumers to demand less of the product that created the negative externality in the first place. This Pigovian theory, however, runs counter to the empirical successes of the 1990 Acid Rain Program, which used the Coase Theorem to create a market-based cap-and-trade program to reduce acid rain. This paper examines both theories and concludes that the Coase Theorem provides a better model for reducing negative externalities such as carbon emissions than does a Pigovian tax.

Keywords: Carbon tax, Cap-and-trade, Pigovian tax, Coase's Theorem

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Introduction

Carbon Emissions

The Environmental Protection Agency ("EPA") classifies carbon dioxide ("CO2") as a greenhouse gas because it traps heat that would otherwise escape from the Earth's atmosphere (NAS 2011). The generation of electrical power - whether through burning oil, natural gas or coal - represents 41 percent of total CO2 emissions (EPA 2011). Many scientists believe that the atmospheric buildup of CO2 is the primary cause of the increase in global temperatures seen in recent decades (EPA 2011). Regardless of one's stance on the cause of global warming, there is no question that the amount of CO2 emitted by the United States has grown rapidly during the last 200 years (see Figure 1 below).

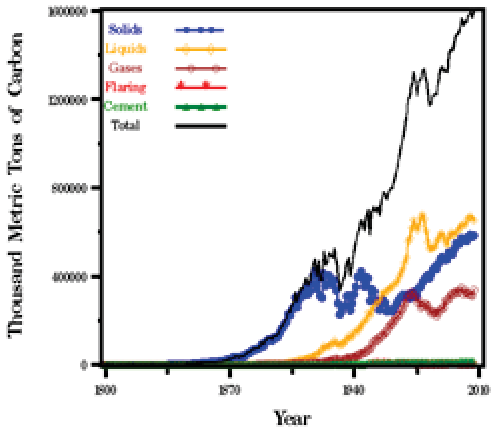

Figure 1 Carbon Dioxide Information Analysis Center

When these carbon emission measurements are overlaid against observable temperature data, as shown in Figure 2, it is not difficult to see why scientists have made the correlation between carbon emissions and climate change.

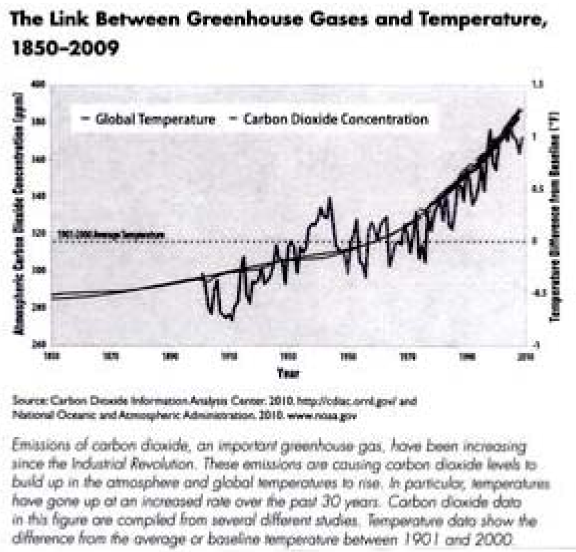

Figure 2

Negative Externality

A negative externality exists when the actions of one party have an effect on another party or parties, but the cost of that effect is not born by the party who caused the negative effect (Stiglitz 2000). Suppose a manufacturer dumps toxic waste into a local watershed, rather than appropriately disposing of it as hazardous waste. This shortcut allows the manufacturer to lower its cost of production from what it would be if it had to pay the cost of properly disposing of the waste. However, anyone who lives near the plant will have to (1) incur the cost of cleaning the water or (2) pay for alternative sources of clean water. Either way, the manufacturer has shifted its costs to nearby residents. Externalities are a market failure because costs or benefits are not fully reflected in market prices

From a market efficiency standpoint, negative externalities are problematic because producers are incentivized to over produce goods that generate negative externalities. For example, every summer an oxygen-depleted "dead zone" occurs in the Gulf of Mexico as rain washes excess fertilizers off farms along the Mississippi River basin into the Gulf (Costello 2009). Unfortunately, because the fertilizer helps the farmers grow more crops and the farmers do not have to pay for the economic damage suffered by Gulf Coast seafood producers and others, the farmers are incentivized to apply more and more fertilizer to their fields. This misallocation of economic resources is traditionally labeled as a market failure because the result is not socially optimal. That is, because the market place fails to charge the producer for the full costs of its production, society ends up with an overproduction of goods generating negative externalities (Seidman 2009).

Yet another problem in dealing with negative externalities is the potential for unintended consequences. Say, for example, local authorities impose regulations on the manufacturer above, compelling him to properly dispose of his hazardous waste or risk fines or even jail time. Such regulations are both good and bad for local residents. On the one hand, local residents will no longer bear the cost of the negative externality. On the other hand, some of them might lose their jobs if the increased regulatory cost drives the manufacturer to lay off workers or, to relocate to a different jurisdiction that does not require it to regulate waste disposal.

Summary

The economic consequences of reducingCO2 are not trivial. Because per capita income is highly correlated with CO2 emissions, any attempt at reducing them will inevitably threaten jobs (EPA 2009). The goal, therefore, is to develop policies that fully account for the social cost of the negative externalities created by carbon emissions, while minimizing the economic impact of those policies. Because the two most commonly cited solutions are cap-and-trade and a carbon tax, this paper explores the relative merits of a market-based cap-and-trade system versus a government-assessed carbon tax based on the assumption that the public policy decision to reduce carbon emissions has already been made.

Cap-and-Trade

Coase Theorem

Negative externalities, such as carbon emissions, occur when producers do not have to pay for the full cost of their actions (Stiglitz 2000). The Coase Theorem addresses this problem by creating a property right for the externality and allowing parties to trade allowances. In Coase's world, it does not matter who has ownership of these property rights, so long as they are fully distributed to all participants who are allowed to trade them freely (Coase 1960). While the Coase Theorem calls for the government entity to grant the initial property rights, the subsequent pricing of these rights is determined by trade between private parties.

A quick concrete example may be helpful. Say, I am a nonsmoker, but you smoke. Let's also say the government has established that I have the right to eat in a smoke-free room. If we are sitting in the same room and you want to smoke a cigarette, you have two options. You can either leave the room, or you can bargain with me to allow you to smoke for a fee. While it may appear that I have the upper hand because I can force you to step outside to smoke, your leverage is the possibility of a fee if I accept your offer.

Cap-and-Trade

Cap-and-trade is a practical application the Coase Theorem. It aims to control emissions by setting a "cap" on the total amount of carbon emissions permitted to be released on a plant by plant basis. If a source wants to exceed its cap, the source must purchase additional cap space from other participants who have unused credits or pay a large fine (NAS 2011).

The typical plan calls for the EPA to set an annual cap on total carbon emissions. The EPA then divides the total cap into allowances for emitting one ton of CO_2 and distributes these allowances on a plant-by-plant basis. At the end of the year, each plant covered under the plan must surrender allowances to the EPA sufficient to cover the quantity of CO_2 emitted. If a specific plant has excess emissions, the EPA imposes a penalty that is greater than the potential highest price of any traded allowance (EPA 2011).

The typical cap-and-trade plan sets the total per-plant allowances to equal current emission levels and reduce them over time. Firms that produce less than their allowance can sell their unused allowance to firms that anticipate emitting more than their allowance. The idea is to incentivize producers to invest in abatement technology and allow them to offset their costs by selling unused allowances to less-efficient producers. Rather than mandating a specific technology, the flexibility afforded by emissions trading markets helps identify where emission reductions can be achieved most cost-effectively. Cap-and-trade thus stimulates the development of new technological solutions that can enable deeper emissions cuts at lower cost in the future.

Carbon Tax

Pigovian Taxes

Arthur C. Pigou, a British economist, is widely credited for advocating taxes on negative externalities as a means for discouraging their production (Pigou 1952). Called "Pigovian taxes," his theory is to tax an externality at a rate equal to the social damages caused or the social marginal benefit of eliminating the negative externality. The additional tax cost will motivate emitters to cut production to the extent that the cost of reducing the negative externality is less than the cost of paying the tax.

Say, for example, Figure 4 represents a firm's equilibrium supply and demand curve at P*, which is a pre-tax sales price that does not reflect what the firm must pay for the cost of its CO_2 emissions. In a competitive market, P* will vary until it reaches Q*, which is where the quantity demanded by consumers at P* equals the quantity supplied.

Now suppose a taxing authority imposes a CO_2 tax. In response, the firm raises its price to Pt in an attempt to recover the cost of the tax. The increase in price causes the supply and demand equilibrium shift to the left as the quantity demanded shifts to Qt. The resulting triangle, as represented by points a, b, and c, is typically called a dead weight loss because the new equilibrium point is below what it would have been without the carbon tax.

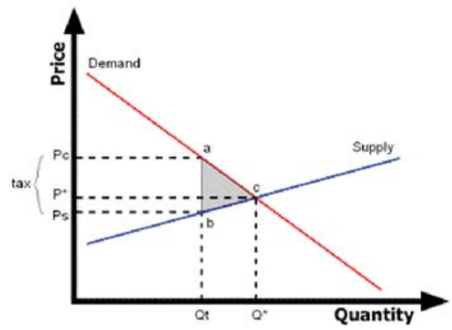

Figure 4

Ordinarily, economists oppose such taxes because the resulting market equilibrium is suboptimal. Supports of Pigovian taxes, however, argue that a tax that produces a dead weight loss is nonetheless socially beneficial so long as it forces producers to internalize the cost of the negative externality. Once producers have internalized this costs and attempt to recover them by passing them on to consumers through increased prices, consumers will demand less of the good, which in turn will reduce production of its related externality. Said another way, the dead-weight equilibrium point caused by a Pigovian tax, such as a carbon tax, approximates the point where supply and demand would have been if the CO2 negative externality had always been internalized.

Carbon Tax

The typical carbon tax proposal calls for the federal government to assess a tax for each ton of CO2 emitted or for each ton of carbon contained in fossil fuels otherwise used in production (CBO 2008). Thus, while a carbon tax fixes the cost of emitting CO2, it does not specify how much CO2 emissions must be reduced. Perhaps the most well-known carbon tax proposal is Dr. William Nordhaus's proposal that calls for a phased-in tax on coal-fired power plants as follows:

2013: $8 per ton, which would raise gasoline prices by 8 cents a gallon and generate $40 billion in tax revenue.
2015: $25 per ton, which would raise gasoline prices by 26 cents a gallon and generate $123 billion in tax revenue.
2020: $40 per ton, which would raise gasoline prices by 42 cents a gallon and generate $200 billion in tax revenue.
(Nordhaus 2010)

According to Alan Blinder, a former vice chairman of the Federal Reserve, the Nordhaus proposal would stimulate economic growth: "Once America's entrepreneurs and corporate executives see lucrative opportunities from carbon-saving devices and technologies, they will start investing right away. *** I can hardly wait to witness the outpouring of ideas it would unleash. The next Steve Jobs, Bill Gates and Mark Zuckerberg are waiting in the wings to make themselves rich by helping the environment" (Blinder 2011).

To soften the Pigovian blow, carbon tax advocates often propose two revenue-neutral tax ideas to ameliorate the impact of higher prices on consumers. The first is a so-called 100 percent dividend proposal:

> For example, let's start with a tax large enough to affect purchasing decisions: a carbon tax that adds one dollar to the price of a gallon of gas. That's a carbon price of about $115 per ton of CO2. That tax rate yields $670 billion per year. We return 100 percent of that money to the public. Each adult legal resident gets one share, which is $3000 per year, $250 per month deposited in their bank account. Half shares for each child up to a maximum of two children per family. So a tax rate of $115 per ton yields a dividend of $9,000 per year for a family with two children, $750 per month (Hansen 2009)

The second idea is a "tax-shift" where a carbon tax reduces existing taxes, such as the federal payroll tax or gasoline tax, on a dollar-for-a-dollar basis (Carbon Tax Center 2010). While the tax-shift proposal is not as straight-forward as the 100 percent dividend, the concept remains the same, i.e., it makes the carbon tax revenue neutral for consumers.

Another plan for minimizing the economic impact of carbon taxes is to use the revenue to fund research into alternative energy (Galiana 2009). Going back to the Nordhaus proposal, for example, an eight dollar per ton tax could generate $40 billion a year, which can be used to fund alternative energy research at a cost of eight cents per gallon. Thus, according to the proponents of this plan, a relatively small price per gallon will generate significant research dollars.

Advocates of a carbon tax also point to its simplicity. One study claims that an upstream carbon tax could cover 80 percent of total emissions in the United States by collecting the tax from less than 3,000 emitters (Metcalf 2009). Milne captured the typical attitude of carbon tax supporters when she said, "In short, carbon taxes offer cost certainty and simplicity. In 10 years, we may have questions about whether the IRS is auditing enough carbon tax returns, but we won't be wondering about whether middlemen are making too much money from allowance trading, if investors are manipulating the carbon market, or what new laws we need to guard against those risks" (Milne 2008).

Cap-and-Trade v. a Carbon Tax

Cap-and-trade and a carbon tax both fix a price for the negative externality of CO2 emissions. The two significant differences between the proposals are how they: (1) establish prices, and (2) reduce emissions. Cap-and-trade fixes the quantity, but lets the market place set the price. A carbon tax fixes the price but does not limit emissions (EPA 2010). Consequently, cap-and-trade meets the emission issue head on, but relies on private market forces to level out the economic costs of reducing emissions. A carbon tax, by contrast, is an indirect tax that relies on direct government intervention to deal with the resulting economic consequences.

Reduced to its most elemental level, the question becomes - who do you trust, free markets or government regulators? Many academics clearly mistrust market-based solutions:

> Cap-and-trade is doomed to failure. It might lead to some new and substantial revenues for the government, but it can never succeed at limiting carbon dioxide emissions. The reason is very simple: A hard cap on emissions would inevitably lead to increases in the costs of energy, which will lead to increasing costs throughout the economy. If these costs are felt by consumers (which is of course what such a policy is designed to do) then they will complain. No elected official will want unhappy constituents, so they will work hard to help people avoid the increasing costs. *** Putting a price on carbon, however, makes good sense. A straight carbon tax - at

> whatever level would be politically acceptable - is a far better place to start than with a fully gamed cap-and-trade system. The point of such a tax would not be to change behavior, but to start the process of pricing carbon directly and to raise some significant revenue for clean energy investments (Pielke 2009).

1990 Acid Rain Program

The Problem

"Acid rain," refers to rain water with excess amounts of sulfur dioxide (SO2) and nitrogen oxides (NOx). Both SO2 and NOx are byproducts of electric power generation, most notably from the burning of coal. Acid rain moves through soil, vegetation, and surface waters and, in turn, sets off a cascade of adverse ecological effects. Recent water quality data show that 41 percent of lakes in the Adirondack Mountain region of New York and 15 percent of lakes in New England exhibit signs of chronic and/or episodic acidification (Driscoll et al 2001). Acid rain can also damage human health. SO2 and NOx can interact to form nitrate particles that can lead to increased illness and premature death from heart and lung disorders, such as asthma and bronchitis (EPA 2011)

The Solution

Title IV of the 1990 Amendments to the Clean Air Act ("ARP") set an upper limit on annual SO2 emissions by 8.4 million tons from specific power plants that were below 1980 levels. To achieve these reductions, the law established an allowance trading program whereby each utility was given allowances equal to their historic emissions rate. The plants could then sell allowances that exceeded their emissions or bank them for use in future years. Each plant could choose its own way of reducing SO2 emissions, such as installing new control technology, switching to lower-sulfur fuel, or optimizing existing controls. Any SO2 source that failed to hold enough allowances to match its SO2 emissions for the previous year had to pay a penalty of $2,000 per ton of excess emissions (EPA 2007)

The Results

As shown in Figure 5, the ARP reduced annual SO2 emissions by more than 40 percent and NOx emissions by almost 50 percent by the end of 2006. These reductions occurred while the combustion of fossils fuels for electricity generation increased by almost 40 percent. Moreover, estimates for the annual ecological and health benefits of the ARP are as high as $142 billion by 2010, whereas estimates of annual compliance costs are only $3.5 billion (EPA 2007).

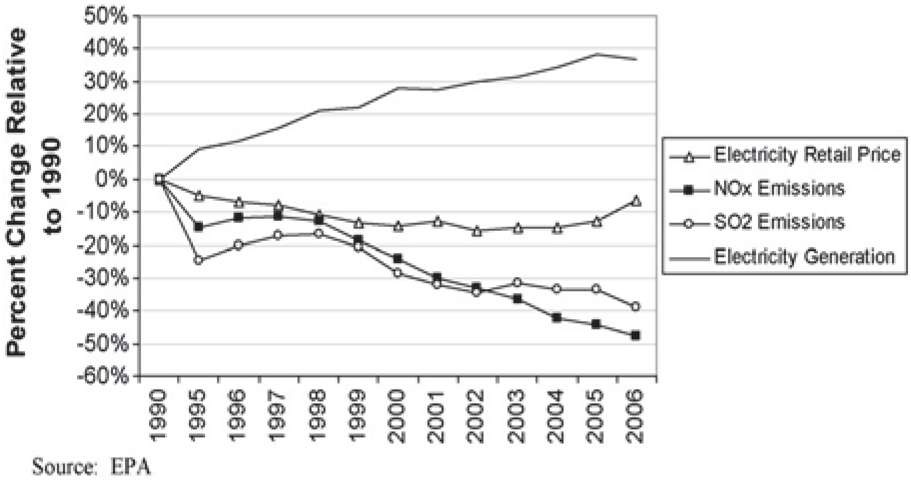

Figure 5

The EPA also noted it had originally projected that the ARP would result in a loss of 13,000 to 16,000 mining jobs by 2001. However, in 2000, the EPA reduced that estimate to 4,100 jobs lost (EPA 2001).

According to the Environmental Defense Fund ("EDF"), the ARP resulted in: (1) An 100 percent compliance in reducing SO2 emissions; (2) A market price for SO2 allowances that was 80 percent lower than what was originally projected; and (3) Actual compliance costs that, per the Office of Management and Budget, were 80 to 70 percent less than forecast. In explaining why the market-based program worked so well, the EDF said, "Markets provide greater environmental effectiveness than command-and-control regulation because they turn pollution reductions into marketable assets. In doing so, this system creates tangible financial rewards for environmental performance. Because cap-and-trade gives pollution reductions a value in the marketplace, the system prompts technological and process innovations that reduce pollution down to or beyond required levels. This point is not theoretical; experience has shown these results" (EDF 2009).

Finally, the EPA summarized its conclusions stating, "The authors' 15 years of experience with the Acid Rain Program suggests that for regional or larger-scale air pollution problems, such as acid rain and pollution transport, a well-designed cap-and-trade program can be cost-effective, flexible, and easy to implement with clear benefits that can be sustained into the future (EPA 2007)."

Conclusion

It is difficult to reconcile the enthusiasm for carbon taxation against the empirical ARP cap-and-trade results. Granted, as carbon tax proponents like to point out, a carbon tax without redistribution is the simplest solution for reducing CO2 emissions. However, once a "tax and dividend" or a "tax and research" option is added to the mix, the simplicity gains of carbon taxes no longer become apparent.

Further, the focus on simplification gains may be misplaced. If the goal is to reduce CO2 emissions, a cap-and-trade program works because it directly reduces emissions. A carbon tax, conversely, only indirectly reduces emissions. Depending on the price elasticity of the good produced or the cost of abatement procedures, some producers may prefer to pay the tax instead of cutting emissions.

Finally, despite all the objective arguments, it appears the underlying reason for the carbon-tax bias has more to do with a mistrust of any market-based solution than a belief in the inherent ability of a Pigovian tax for eliminating CO2 emissions. Carbon tax advocates imply that firms acting in their own self-interest cannot be trusted to reach a socially acceptable solution for reducing CO2 emissions. While this conclusion sounds harsh, how else is it possible to explain the continued advocacy for a carbon tax scheme in light of the evidence from the 1990 Acid Rain Act proving that a cap-and-trade program reduced emissions at a lower than expected cost. Perhaps it is wiser to stick with what has worked instead of reinventing the wheel.

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