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Getting the Carbon Tax Right: Issues in Carbon Tax Design

Jonathan Thomas

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Abstract

Global warming poses a threat to the environment. Many prominent economists advocate a carbon tax over a cap-and-trade system as a means of reducing carbon emissions; yet there is no single way of taxing carbon. By seeing why the carbon tax is a useful instrument in combating climate change and analyzing the three most popular means of carbon taxation – the flat carbon tax, BTU tax, and the gasoline tax – we can develop a carbon added tax that borrows from these existing proposals and creates a new carbon tax that most effectively addresses the roles of consumers and producers in reducing emissions.

I. Introduction

With the release of Al Gore's documentary "An Inconvenient Truth," the looming threat of global warming entered the public spotlight once again. It has also caused some debate in economic circles on the best way to address the problem. While some economists are in favor of the politically popular cap-and-trade, many of them are strongly leaning towards a carbon tax. Most notable of these carbon tax supporters is the renowned Harvard economist N. Gregory Mankiw, who wrote in the October 26th, 2006 *The Wall Street Journal* op-ed simply entitled "Raise the Gas Tax." In the article, Mankiw argues for a ten cent increase over a ten year period for gasoline prices as a Pigouvian tax to correct for externalities associated with CO_2 emissions. With the op-ed piece, he has become the head of the unofficial "Pigou Club," a list of public figures who have displayed public interest in carbon taxes. Notable members, as Mankiw records on his popular blog, include figures such as Al Gore, Joseph Stiglitz, Steven Levitt, Alan Greenspan, and many others (Mankiw "Rogoff Joins the Pigou Club" 2006). However, each of these figures seem to have a different idea of the ideal carbon tax to combat global warming. This brings up the question: if we are to tax carbon, what is the best way to go about it?

This paper will address that issue. First, it is necessary to look at the chief alternative to the carbon tax - the cap-and-trade system - and see why the carbon tax is a better option than the cap-and-trade system. Next, we look at three of the most popular ways to tax carbon – the flat carbon

tax, BTU tax, and gasoline tax – with special attention to the theoretical basis for these models and efficiency in combating global warming. Finally, a proposal for an ideal carbon tax is presented, combining strengths of the other models and affecting both consumers' and producers' emissions.

II. Why the Carbon Tax and not Cap-And-Trade

The chief alternative to the carbon tax is that of the cap-and-trade system. The concept is rooted in Coase's theorem (Coase 1960). Problems with public goods (such as CO_2 emissions), can be remedied by assigning property rights. The government could assign property rights to carbon, in the form of carbon emission permits, issue them to producers and let them trade amongst themselves. Historically, in the case of SO_2 emissions, the issue of SO_2 emission permits helped reduce emissions in the US (Burtraw *et al.* 2005). Therefore, it seems likely that a similar system with CO_2 emissions, such as seen in the CO_2 trading markets in the European Union and the Chicago Climate Exchange, would have similar results in reducing CO_2 emissions.However, it is necessary though to take a closer look at the cap-and-trade system.

While the cap-and-trade system is an effective instrument in combating emissions, it has several weaknesses. One of its chief weaknesses is its inflexibility. Under such a system, carbon permits become an asset to a company (Dower *et al.* 1992). If the government wants to raise its goals, it has two options: buy back the permits or recall them. The former may prove to be expensive, while the latter may be

difficult as producers would be reluctant to give up valuable assets in terms of emission permits (Dower *et al.* 1992) The carbon tax scheme would be more flexible as if standards were too strict or too lenient, prices could be lowered or raised, respectively (Green *et al.* 2007). Particularly, this is useful in regards to the uncertainty associated with the problem of global warming. The other main weakness the cap-and-trade system is that it proves to be too volatile and uncertain compared to the carbon tax. As prices change in accordance to market forces, they can easily fluctuate up and down like any other commodity. As a result, energy rates can wildly vary, as seen in European Union's Energy Trading Scheme or the Californian RECLAIM (Green *et al.* 2007). The carbon tax avoids this, as the tax is set and it guarantees a degree of certainty in prices, putting consumers and producers alike at ease. The carbon tax seems to have quite an advantage over the cap-and-trade system.

The supporter of the cap-and-trade system, however, may point out some faults of the carbon tax. They will most likely argue that the carbon tax is regressive. Unfortunately, it is true – any incarnation of carbon tax will have a regressive nature, where the less well off will end up spending a greater percentage of their income for the tax. However, as *The Wall Street Journal* (2007) shows, the cap-and-trade system would be just as regressive, with the poorest having to spend an extra 3.3% of their income as a result of cap-and-trade. The carbon tax has an advantage in this area too - it provides a steady stream of revenue to compensate these "losers." Also, environmentalists may object to the carbon tax, arguing it is a permit to pollute at will. While the carbon tax is not as restrictive as the

cap-and-trade system in establishing a mandated quota, it is still a powerful instrument as it ensures that the socially optimal rate of pollution is emitted.

III. The Flat Carbon Tax

The first method of carbon taxation is that of the flat tax on carbon emitted. In this model, a flat fee would be imposed per ton of carbon. In doing this, producers will pay a higher cost in emitting carbon and thus have a greater incentive to conserve and abate.

There are some advantages to this method. By raising the price to emit, firms will either have to pass the cost to the consumers (and possibly incur costs of losing customers on top of the tax) or abate. In either case, firms who emit less will end up being rewarded in this system. Thus, this tax appears to be an effective tool in combating climate change and influencing firms'and consumers' behavior. The success of similar flat carbon taxes in Scandinavian countries such as Sweden and Denmark seem to bolster the argument for such a model (Poterba 1993). However, it is necessary to look at some of the weaknesses in this taxation scheme.

Upon closer examination, this model does seem to have a few weaknesses. As Poterba points out, a low flat tax can prove to be ineffective, hence why Poterba pushes for a $100/ton carbon tax (Poterba 1993). Yet will this be effective? To a degree it will be. Firms may abate or pass the cost to the consumer, as mentioned, but it could very well pay to pollute by cutting costs elsewhere. While this will generate plenty of revenue as firms will have to pay, it will not help reduce carbon emissions.

Furthermore, the producer side approach may not be the optimal way of addressing a problem such as global warming. An ideal carbon tax, it seems, should directly inform consumers to alter their behaviors in a more direct way than an indirect way from a flat carbon tax on producers. Despite some of these weaknesses, this model will serve as a basis of the latter discussion of the ideal carbon tax.

IV. The BTU Tax

Another alternative, popularized by the Clinton administration, is that of the BTU tax. The BTU tax focuses more on taxing energy per BTU unit as opposed to carbon (Parry and Williams 1998). This does seem to help promote energy conservation, as taxing all forms of energy would encourage producers and consumers to save energy. However, it is necessary to see how the BTU tax is a very nonviable option in combating climate change.

There are a few reasons why the BTU tax, while a viable option for promoting energy conservation, is not viable for addressing climate change. First, as Parry and Williams point out, a BTU tax would cost more than a flat carbon tax for similar results (Parry and Williams 1998). The major issue with the BTU tax is the incentives it creates. Under such a model, coal, one of the chief contributors to CO_2 emissions, would be taxed less since it energy per unit is relatively low compared to the cleaner yet less efficient natural gas (Parry and Williams 1998). Ideally, we would want a reverse result – coal should be taxed higher to discourage usage and to encourage usage of cleaner forms of energy such as natural gas.

Therefore, while the BTU tax is ideal for addressing energy consumption, it is weak in addressing carbon emissions. However, it will serve as a useful aide in designing an ideal carbon tax by ensuring it focuses on reducing carbon emissions directly, not via energy consumption alone.

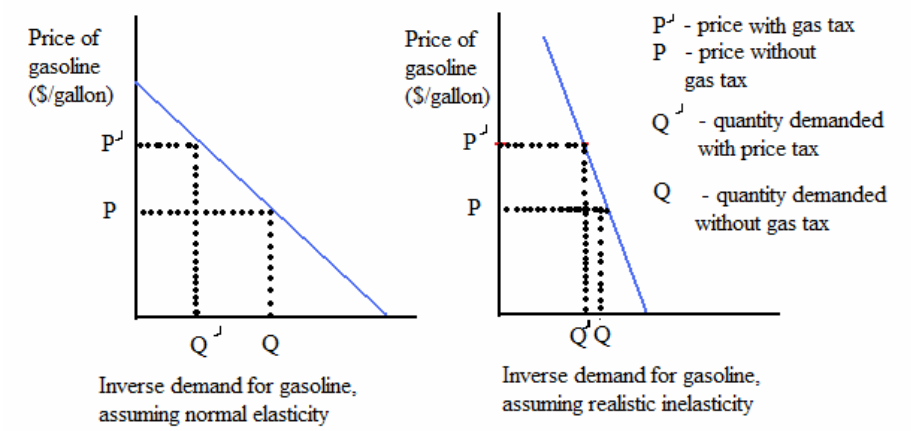
V. The Gas Tax

With Mankiw's op-ed piece, as previously mentioned, the gas tax has been reintroduced as the ideal way of combating global warming along with other problems such as roadway congestion. The gas tax does seem like a likely candidate as a way to tax carbon. As shown in *The Economist* (2007), the US consumes more gasoline than the rest of the world combined on a daily basis. This is turn means a higher amount of carbon emitted into the atmosphere. In addition, the US has the lowest fuel prices in the industrialized world, as also seen in the table. It seems that if we are to combat global warming, it is necessary to address the high oil consumption at low prices by attaching a carbon tax.

It is necessary to briefly describe the theory behind the gas tax. Much like the other taxes, it too is a tax designed to work with the laws of supply and demand. Consumers will tend to demand more of a good at lower prices, and less of a good at higher prices. High emissions of CO_2 can partially be traced due to high oil demand exacerbated by low gasoline prices. It thus follows that in order to discourage gasoline consumption by lowering demand. We can do so by raising the price of gasoline. While there are currently taxes on gasoline, they mostly act as a user fee for use of public roads (Parry and Small 2005). One of the prominent

discussions of the subject of gasoline taxes by Parry and Small suggest that the current gasoline taxes in the USA are too low and should be raised to $1.01/gallon. In their analytical model, consumers will respond to higher fuel prices by driving less and purchasing more fuel efficient vehicles. This gasoline tax will also help reach Parry and Small's optimal tax in addressing climate change, a vehicle miles traveled tax in order to reduce the actual amount of emissions (driving less will obviously lead to less emissions generated). This seems like a very understandable, viable option based on our existing gasoline taxes, yet there are a few problems.

First, Parry and Williams note in an earlier paper that a gasoline tax would be quite costly. A gasoline tax would cost between 4 and 5% of GDP, compared to an approximate .2% for a flat carbon tax and slightly more for the BTU tax (Parry and Williams 1998) . The major issue, however, is the neglect of the issue of inelasticity. Gasoline is said to be an inelastic good. Inelastic goods, such as gasoline, mean that as prices go up, quantity demand changes only slightly (see graph below).



Affect of a Gasoline Tax on Quantity Demanded of Gasoline

Thus, if we increase gas prices, people may slightly alter their behavior, but it will take some time before people to fully adjust to changes. Furthermore, the high prices may actually have an unintended consequence in the goal of combating global warming. Higher gas prices may induce oil producers to seek out new reserves to increase supply and lower prices. There is also the threat of cost-push inflation, where the excessive rise in gasoline prices, a major price input with no close substitutes in the short run, can lead to an overall increase in prices. Despite these downfalls, this is a step in the right direction in creating an ideal carbon tax that addresses both consumers' and producers' role in abating carbon.

The Carbon Added Tax - A New Method from an Old Instrument

It seems that based on the three most popular carbon tax instruments examined, an ideal carbon tax is one that has the strength of

the three - the ability to tax carbon in order to discourage consumption in order to abate emissions - yet be Pareto efficient and still effective in addressing global warming. For this, a look at some basic economic ideas of incentives and the power of choice to aid us in developing such an ideal tax. From this, the carbon added tax is born.

The carbon added tax seems to be a good tax for combating global warming, by taking not only standard subjects to carbon taxation (energy, fuel, etc.) but consumers good as well by factoring in the carbon emitted during each stage of production and directly applying it to the cost of the product. This would be very similar to the value added tax used in many industrialized nations, except based on carbon emitted. To illustrate, consider how a value added tax (VAT) works. In such a scheme, a miller pays a VAT when they buy the farmer's wheat; the baker pays a VAT when they buy the miller's flour; and the consumer pays a VAT when they buy the baker's bread. The cost of the final product, bread, will be higher due to factoring in the taxes from each step in the process than without a tax. A carbon added tax would work similarly. The miller would pay a carbon added tax to pay for the emissions generated in the wheat harvesting process; the baker pays a carbon added tax for the emissions generated during the milling process; and the consumer pays for emissions generated during the baking process. This is slightly different from the VAT as instead of a flat fee; it will depend on the carbon emitted in the process. This fact is a great strength for the carbon added tax.

Why is taxing based on carbon emissions universally essential to

combating global warming? One of the greatest calls from environmentalists is the need for consumers to alter their habits in light of the threat of global warming. A carbon added tax would provide such an incentive. People will opt for less carbon intensive goods because they are cheaper. Producers who are more carbon intensive will have a greater incentive to innovate to reduce their emissions in order to regain lost revenue from consumers buying less carbon intensive good. With this approach, consumers will be able to be more carbon friendly.

It is important to note that the carbon added tax is not a rejection of the previously mentioned carbon taxes but rather a natural extension combining them, along with other miscellaneous taxes designed to combat global warming. Ideally, this carbon added tax would be based on a flat carbon tax, mostly the $15/ton (a figure being endorsed by the American Enterprise Institute heavily and received publicity in Gregory Mankiw's recent piece in *The New York Times* from September 16th, 2007 "One Answer to Global Warming: A New Tax"). As mentioned in *The Wall Street Journal* (2007), a $15/ton tax would affect not only tax energy rates but would also encompass gasoline along with other sources of energy. With that in mind, such a carbon added tax can help promote alternative forms of energy. If carbon heavy industries such as coal were taxed in such a way, they may be able to rise in such a way that alternative forms such as solar and wind are just as affordable, if not cheaper than currently cheap coal. It would also be similar to taxes imposed elsewhere. A carbon added tax would ideally make a hybrid car be taxes less than an SUV (though we are dealing with potential to emit on top of the actual

emission created in the process, a special carbon added tax could be applied to take this into account). This is similar to car taxes in China and Scandinavia designed to discourage car ownership. While this tax would not totally discourage car ownership, it would strive to provide a greater incentive to those who purchase more fuel efficient vehicles as opposed to a gas guzzling SUV. A carbon added tax on emissions from commercial flights, a major contributor to global warming, would be very similar to the UK's current Air Passenger Duty designed to combat global warming; yet under a carbon added tax, it would not be a flat fee but based on the carbon emitted during the flight and thus will encourage more carbon friendly planes for longer trips or adjusted travel plans on the part of consumers. In short, a carbon added tax is not ultimately a radically new concept but rather based on existing carbon tax methods and focusing on the reduction of carbon while still providing choices to consumers.

There are some likely objections to this carbon added tax. Under such a scheme, items transported from a distance could be an economic hindrance. Technically, carbon is emitted in transporting goods so consumers in New York would be charged far more for Washington grown apples as opposed to New York grown apples due to the greater distance the former traveled. While this may please the "think globally, buy locally" crowd, it is not efficient to create a condition where there is a greater incentive to be locally sufficient as opposed to allowing for trade and specialization, cornerstones of a capitalistic society. In that case, some factor should be taken for distance yet be a rather small fraction compared to the flat base for the carbon added tax. On a similar note,

foreign trade may need some special exception as a carbon added tax could seem like an unfair tariff, as in most cases a foreign good will travel farther and thus create more carbon emissions than something domestically produced. In this respect, however, a carbon tariff on foreign goods without carbon abatement programs could turn trade into a tool to help bring multilateral action to fight global warming. Secondly, there is the obvious issue that this is, like the other taxes mentioned, regressive. As proposed by Parry and Small (2005), Poterba (1993), and others in their respective models, we can compensate by offering more tax cuts, particularly increasing the Earned Income Tax Credit, without too much concern as we will be getting revenue from the carbon added tax. Finally, there may be an issue that this is a rather radical approach and too bulky and burdensome to administer. It may appear so, but in reality, this is not an issue. One of the marvelous things about the carbon tax in general, is that it helps eliminate unnecessary regulations (ex. CAFE standards) - the increased price in emitting carbon will solve it (Green *et al.* 2007). Furthermore, we would be reducing burden to the current income tax system, freeing up more resources. In terms of calculating carbon emissions, many third parties focusing on carbon offsetting, such as NativeEnergy, can approximately calculate the carbon emitted by various vehicles, forms of energy (like coal, wind power, etc.). It seems reasonable that this can be applied to any consumer good, especially when the basis is that of a flat tax of $15/ton which will determine the tax on the good. While all these objections are warranted, they do not undermine the optimality of the carbon added tax.

Conclusion

In order to fight global warming, action is needed to reduce the amount of CO_2 emitted into the atmosphere. However, it is necessary to ensure that this is done in an efficient way. The cap-and-trade system seems to fall short compared to the carbon tax as a method of abating carbon emissions. Three of the most popular means of carbon taxes – the flat fee tax, BTU tax, and the gasoline tax – have various strengths and weaknesses. A carbon added tax, a tax based on the carbon emitted during the various stages of production on a good, takes the premise behind these three methods and extends it further. With this carbon added tax, consumers and producers alike have a greater incentive to be more "carbon friendly." Finally, in "An Inconvenient Truth," Al Gore believes there is a (false) dichotomy of either "gold" or wealth versus the planet Earth. The carbon added tax proves that this not necessarily the case, how it can create wealth and still manage to thwart the "inconvenient truth" of global warming. With this in mind, we have the groundwork to expand this proposal into a more technical model for estimating and implementing the carbon added tax.

References

Burtraw, Dallas, David A. Evans, Alan Krupnick, Karen Palmer, and Russell Toth. "Economics of Pollution Trading for SO_2 and NO_x." Washington, DC: Resources for the Future, 2005. Available from http://www.rff.org/rff/Documents/RFF-DP-05-05.pdf. Internet; accessed 21 September 2007.

Coase, R.H. "The Problem of Social Cost," in The Federal Judge's Desk Reference to Environmental Economics. Edited by John A. Baden, 86-100. San Francisco: Pacific Research Institute for Public Policy, 1998. Originally published in *The Journal of Law & Economics*, October 1960.

Dower, Robert C, and Mary Zimmerman. The right climate for carbon taxes: creating economic incentives to protect the atmosphere. Washington, D.C.: World Resources Institute, 1992.

Economist, The. "Petrol: Hands to the Pump." Published on-line at http://www.economist.com/displaystory.cfm?story_id=9430924, July 3, 2007. Accessed 15 February, 2008.

Green, Kenneth, Steven F. Hayward, and Kevin A. Hassett. "Climate Change: Caps vs. Taxes." American Enterprise Institute, Environmental Policy Outlook No. 2, June 2007. Available from http://aei.org/publications/pubID.26286,filter.all/pub_detail.asp. Internet; accessed 21 September 2007.

Mankiw, N. Gregory. "Rogoff Joins the Pigou Club." Available from http://gregmankiw.blogspot.com/2006/09/rogoff-joins-pigou-club.html. Internet; accessed 14 February 2008.

Parry, Ian and Small, Kenneth. "Does Britain or the United States Have the Right Gasoline Tax?" *American Economic Review* **95(4)** (2005): 1276-1289.

Parry, Ian and Williams III, Roberton. "A Second-Best Evaluation of Eight Policy Instruments to Reduce Carbon Emissions." Washington, DC: Resources for the Future, 1998. Available from http://www.rff.org/parry/Environment/CO2_REE.pdf. Internet; accessed 21 September 2007.

Poterba, James. "Global Warming Policy: A Public Finance Perspective." *Journal of Economic Perspectives* **7(4)** (1993): 47-63.

Wall Street Journal, The. "Climate Change's Great Divide," 9/12/2007.