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Calling the Carbon Bluff

Why not tie carbon taxes to actual levels of warming? Both skeptics and alarmists should expect their wishes to be answered

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After much effort, G8 leaders agreed earlier this year to "stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system." This is the same wording as in Article Two of the UN Framework Convention on Climate Change, signed in 1992. In other words, after months of negotiations, world leaders agreed on a text they had already ratified 15 years earlier.

More recently, leaders at the APEC Summit in Australia agreed to set "aspirational" targets to reduce greenhouse gas emissions, some day, on a voluntary basis.

Meanwhile, at the other pole, people who worry about global warming have been ramping up the rhetoric of alarm. For instance, at a Senate hearing this year, Al Gore referred to a "planetary emergency" of such proportions that we have only 10 years to save our civilization from catastrophe.

Global warming policy is stuck between these poles of alarmism and inaction. The stalemate exists for very basic reasons. Reductions in greenhouse gas emissions (beyond trivial, symbolic gestures) are extremely costly. Such reductions may eventually turn out to be necessary, but important divisions of opinion remain on the extent of humanity's influence on climate, whether or not the situation is a crisis, whether and how much greenhouse gas emissions should be cut, if so how to do it, and what is the most we should be prepared to pay in the process. For those convinced of the need to slash emissions now, the endless questioning seems frustrating and foolish. For those aware of the uncertainties, the proliferation of costly and pointless policy gimmicks (such as banning incandescent light bulbs or plasma TVs) in response to the political pressure to be seen doing "something" seems equally frustrating and foolish.

With this stalemate in mind, I would like to propose an approach to climate policy that could, in principle, get past the stalemate between unachievable targets and pointless gimmicks, while in principle getting equal support from all sides.

The approach is based on two points of expert agreement. First, most economists who have written on carbon dioxide emissions have concluded that an emissions tax is preferable to a cap-and-trade system. The reason is that, while emission abatement costs vary a lot based on the target, the social damages from a tonne of carbon dioxide emissions are roughly constant. The first ton of carbon dioxide imposes the same social cost as the last ton. In this case it is better for policymakers to try to guess the right price for emissions rather than the right cap.

A policymaker trying to guess the right emissions cap is guaranteed to get it wrong, and even small errors can cause huge economic problems, as Europe is discovering as it tries to make a go of its cap and trade system. But on the price side, most studies that have looked at the global social costs per tonne of carbon dioxide (assuming climate models are correct) have found it is likely to be quite low. Even among studies that take climate model projections at face value, the global damages in most of the serious published studies work out to be less than ten dollars (US) per tonne. Policymakers toss around emission cap proposals that vary all over the map: five percent, twenty percent, fifty percent, etc. The reality is that no one knows what the right emissions cap is. But if we want to charge emitters the social costs of their activities, the estimated price is likely to be low. If we put a charge of about five dollars (US) on each tonne of carbon emissions, the market will find the (roughly) correct emissions cap.

Second, climate models predict that, if greenhouse gases are driving climate change, there will be a unique fingerprint in the form of a strong warming trend in the tropical troposphere, the region of the atmosphere up to 15 km altitude, over the tropics from 20 degrees North to 20 degrees South.

This point has not been widely appreciated in the global warming discussion to date. People have come to see signs of "global warming" in the daily weather reports regardless of what happens—warming, freezing, rain, drought, wind, lack of wind, etc; much the way Nostradamus devotees see confirmations of his hazy prophecies in the daily news, no matter what happens or doesn't happen. But while there are many hazy aspects to climate forecasts, the Intergovernmental Panel on Climate Change (IPCC) report from earlier this year puts its stock in the tropical troposphere trend as a clear, unique greenhouse signal that ought to be already visible and that ought to dominate future greenhouse warming. Figure 9.1 of the IPCC Working Group I Fourth Assessment Report presents a climate model hindcast from 1890 to 1999, breaking down expected 20th century changes by forcing factors. Climate changes due to solar intensification and other natural factors do not yield a pattern focused on the tropical troposphere: only greenhouse gas-induced warming does. And the effect is so strong as to dominate the total change. The same result emerges in the 1958-1999 hindcast shown on page 25 of the 2006 US Climate Change Science Program report. According to both assessments, greenhouse gases should have had a large effect on the tropical troposphere by now, it is uniquely associated with greenhouse gases, and it should dominate all other factors by now.

Projections of future climate changes are shown in Figure 10.7 of the IPCC report **[see appendix]**. In the IPCC's on-line supplementary material there are twelve different model results shown, all yielding the identical pattern: a warming bullseye in the tropical troposphere that leads the process and exceeds the warming either at the tropical surface or in the global troposphere as a whole.

It is therefore convenient that we have good quality data for this region of the atmosphere. Temperatures in the tropical troposphere are measured every day using weather satellites and weather balloons. The satellite data are analysed by several teams, including one at the University of Alabama-Huntsville (UAH) and one at Remote Sensing Systems (RSS) in California. According to the UAH team, the mean tropical tropospheric temperature anomaly (its departure from the 1979-1998 average) over the past three years is 0.18 degrees C (as of May 2007). The corresponding RSS estimate is 0.29. Interestingly, neither the satellite data nor the weather balloon data show a statistically significant warming pattern in the tropical troposphere. The IPCC Report, Figure 3.4.3, shows that none of the available satellite or balloon measures of that region exhibit a significant warming trend. Additionally, the tropospheric warming is less than at the tropical surface in most data sets, and less than the global average, counter to model predictions. The US Climate Change Science Report found the same thing.

Leaving aside the model/data discrepancy, we can proceed by putting the science and policy ideas together. Suppose each country implements something called the T3 Tax, which stands for the Tropical Tropospheric Temperature. The US dollar rate would be set equal to 20 times the three-year moving average of the RSS and UAH estimates of the mean tropical tropospheric temperature anomaly, assessed per tonne of carbon equivalent, updated annually. Based on current data the tax would be about US $4.70 per tonne, which is about the median mainstream carbon dioxide damage estimate from a major survey published in 2005 by economist Richard Tol. The tax would be implemented on all domestic carbon dioxide emissions (assessed per tonne of carbon equivalent), all the revenues would be recycled into domestic income or industry tax cuts to maintain fiscal neutrality, and there would be no cap on total emissions.

This tax rate is proposed to begin at a low rate, where it would yield very little emissions abatement but would also be economically innocuous, at least at the macroeconomic level. Global warming skeptics and opponents of greenhouse abatement policy will like that. But would global warming activists? Initially no: they would argue it is ineffective. But if they understand both the climate model forecasts and the way investors make decisions, they should like the policy—because according to them, the tax will climb rapidly in the years ahead, and investors base their current decisions not on current prices but on expectations of future prices.

The IPCC predicts a warming rate in the tropical troposphere of about double that at the surface, implying about 0.2 to 1.2 degrees C per decade in the tropical troposphere under greenhouse forcing scenarios. That implies the tax will climb by $4 to $24 per tonne per decade, a more aggressive schedule of emission fee increases than most current proposals. At the upper end of warming forecasts, the tax could reach over $200 per tonne of CO_2 by 2100, forcing major carbon emission reductions and a global shift to non-carbon energy sources.

If the "science is settled" and the "debate is over" and so forth, investors will know for sure that the carbon tax rate is going up rapidly, and will accordingly plan to scale back use of carbon-intensive energy. Global warming activists would like this. But would skeptics? They should, because if they really believe the models are exaggerating the warming forecasts they can be assured that the carbon tax will not rise. Skeptics can point to the fact that the averaged UAH/RSS tropical troposphere series went up only about 0.08 degrees C over the past decade, implying a decadal trend upward in the T3 tax of only $1.60 if this trend continues. And the mean tropical tropospheric temperature has been going down since 2002. Some solar scientists even expect pronounced cooling to begin in a decade. If they are right, the T3 tax will fall to zero within two decades, and may even turn into a subsidy for carbon emissions.

At this point the global warming alarmists might be tempted to slam the proposal. But not so fast, Mr. Gore: the tax would only become a carbon subsidy if all the climate models are wrong, if greenhouse gases are not warming the atmosphere, if the sun actually controls the climate and if solar output weakens in the years ahead. Alarmists sneeringly denounce such claims as 'denialism' so they can hardly reject the T3 policy on grounds that take them as true. Instead they should cheerfully dismiss such concerns on the oft-repeated basis that there is no uncertainty, the debate is over, and global warming due to greenhouse gases is a settled scientific fact. If *that* is the case, the T3 tax will deliver the stringent carbon emission controls the alarmist side has been wanting.

Under the T3 tax, the regulator gets to call everyone's bluff at once, without gambling in advance on who is right. If the tax goes up, it ought to have. If it doesn't go up, it shouldn't have. Either way we get a sensible outcome. The only people who lose will be those whose positions were disingenuous, such as opponents of greenhouse policy who claim to be skeptical while privately believing greenhouse warming is a crisis, or proponents of greenhouse gas emission cuts who neither understand nor believe the IPCC

projections, but invoke them as a convenient argument on behalf of policies they want on other grounds even if global warming turns out to be untrue.

And the benefits don't stop there. The T3 tax will induce forward-looking behaviour. Alarmists worry that conventional policy operates with too long a lag to prevent damaging climate change. Under the T3 tax, investors planning major industrial projects will need to forecast the tax rate many years ahead, thereby taking into account the most likely path of global warming a decade or more in advance.

And best of all, the T3 tax will encourage private sector climate forecasting. Firms will need good estimates of future tax rates, which will force them to look deeply, and objectively, into the question of whether existing climate forecasts have an alarmist bias. The financial incentives will lead to independent re-assessments of global climate modeling, without regard to what politicians, the IPCC or climatology professors want to hear.

I have received some criticisms of this idea that need to be addressed. First, it seems to be backwards-looking, in that it is based on current and past temperature levels. So doesn't that mean it amounts to closing the barn door after the horse has fled? Actually no. By choosing the tropical troposphere as our metric we are using the atmosphere's own "leading indicator"—the warming there is supposed to be earlier and stronger than warming at the surface. And second, remember that investors are forward-looking. Somebody building a heavy oil upgrader or a pulp mill would not want to know the tax rate today, much less last year; instead he will want to know what the tax rate will be 10 or 20 years from now when the operation is at full capacity. Under the T3 rule, that estimate will have to be based on the best, most objective forecasts of climate change available. Firms will be worse off by either fudging the forecasts or ignoring sound scientific evidence: the best results will accrue to firms incorporating the most accurate climate forecasts into their decision-making, precisely the kind of forward-looking behaviour environmentalists want to encourage. Consequently it's not the case that we have to wait until it is "too late" to respond to global warming. The market will force investors to make the best possible use of information, and to press for improvements in climate forecasting in the process.

Having said that, it is entirely realistic to say that we need to see some actual warming before the climate policy gets stringent. Hard-liners on the policy side might want us to put such complete faith in climate models that we make huge policy investments based only on the assurance that a warming trend currently missing from the data is soon to be observed. But given the costs of large carbon emission reductions, and the apparent tendency of models to over-estimate of the effect of greenhouse gases, this is asking too much of society in general and policy makers in particular. Requirements of basic prudence is satisfied in this case by saying that the current and future changes in the tax rate ought to depend on seeing the actual tropical tropospheric trend, not simply seeing a computer model projection of what it might be, some time in the future.

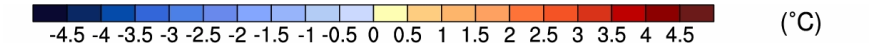
Second, the tax I propose starts small, and environmentalists will object that at this rate it is too low to force emissions down. That is indeed correct. But it is low because the estimates of damages due to greenhouse gas emissions is low. What matters, from an economic point of view, is that emitters will be paying the estimated social costs of their actions. Once they are doing so, the market will find the right level of emissions, even if it is not much different from the unregulated emissions level, until the tax rate has risen substantially higher.

Policymaking in the real world is messy, and ideas that sound good in theory can come out hopelessly gummed up with extraneous provisions that dilute or contradict the original purpose. But as a thought experiment, I find the T3 tax clarifies a lot of issues. My personal view is that the ideal global warming policy is a carbon tax, and the optimal rate is zero. I like the T3 tax in part because I think it would result

in this outcome over time. Yet those whose fears of rapid warming lead them to demand stronger policy measures should, in principle, equally be able to support the T3 tax since they expect it to yield stringent emission controls in the years ahead. In light of the long stalemates over carbon dioxide emissions policy, I know of no other policy that can lay claim to equal support from such polarized camps.

Appendix

These are two of 12 model runs for IPCC Figure 10.7 from the IPCC Fourth Assessment Report Web Site: http://ipcc-wg1.ucar.edu/wg1/Report/suppl/Ch10/Ch10_indiv-maps.html. Each model produces three panels for the time intervals 2011-2030, 2046-2065 and 2080-2099. The colour coding is on this scale:



where the number denotes the change in mean temperature compared to the 1980-1999 average. The horizontal axis shows latitude, from the South Pole on the left to the North Pole on the right. The vertical axis shows altitude. The bullseye at the top middle is the tropical troposphere.