On Setting Near-term Climate Policy while the Dust Begins to Settle:

The Legacy of the *Stern Review*

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Abstract

We review the explosion of commentary that has followed the release of the *Stern Review: The Economics of Climate Change,* and agree with most of what has been written. The *Review* is right when it argues on economic grounds for immediate intervention to reduce emissions of greenhouse gases, but we feel that it is right for the wrong reasons. A persuasive case can be made that climate risks are real and increasingly threatening. If follows that some sort of policy will be required, and the least cost approach necessarily involves starting now. Since policy implemented in 2007 will not "solve" the climate problem, near term interventions can be designed to begin the process by working to avoid locking in high carbon investments and providing adequate incentives for carbon sequestration. We argue that both objectives can be achieved without undue economic harm in the near term by pricing carbon at something on the order of $15 per ton as long as it is understood that the price will increase persistently and predictably at something like the rate of interest; and we express support for a tax alternative to the usual cap-and-trade approach.

Key Words: *Stern Review*, climate change, climate policy, social discount rate; risk and equity aversion

The *Stern Review* (Stern, et al. (2006) and assorted postscripts) went a long way in its attempt to demonstrate how economics has something to say in informing the climate policy debate. Indeed, its release in October of 2006 amounted to a full employment act for economists who know something about climate and some who do not. Its release also inspired some scientists and others who don't know much economics to enter the fray, but that is fine, too. Blogs have been filled with discussions of discounting schemes, damage estimates and the like. The popular press has been littered with coverage and commentary, and the academy has broken all records in moving "reviews of the *Review*" through the peer review process and into print. Four months later, the dust is beginning to clear, and so it is appropriate to take stock. What has the *Stern Review* accomplished in terms of advancing the case for near-term climate policy around the world and, perhaps most importantly, in one of the world's most reluctant policy participants – the United States? That is the point of this paper.

The numerical results reported in the *Review* are controversial and value-laden, but that is the nature of the economic science. In some instances, the controversy has been created by people who want to undermine confidence in the *Review's* fundamental conclusion - the economics of climate policy tells us unambiguously that it is time to act. In other instances, the controversy can be attributed to economists being economists – arguing over every point to make sure that this fundamental conclusion is built on solid analytical and empirical ground. In both cases, unusually harsh words have been said about the *Stern Review*. We have participated in this discussion in large measure because we are convinced that the *Review* provides sufficient evidence to support its fundamental conclusion with very high confidence. We are, though, concerned that this confidence may not have been as influential as it could have been because the *Review* may be right for reasons for the wrong reasons.

Section 1 summarizes briefly what we see as the major messages to be gleaned from the underlying documentation of the *Stern Review*. A more detailed review of the controversial economic estimates follows in Section 2 before a third section offers some insight in possible implications for near-term climate policy. Section 4 focuses attention away from "solving the climate problem" and onto how one might design near-term policy in light of the long-term evolution of mitigation targets. Section 5 suggests why that near-term design might best be sustained by a carbon tax rather than the more popular cap and trade initiatives before a final section offers some concluding remarks.

1. The Major Messages.

The major messages of the *Review's* assessment of the current science are sound. Indeed, they are largely consistent with the conclusions presented by Working Group 1 in its contribution to the Fourth Assessment Report of the Intergovernmental Panel on

Climate Change (IPCC, 2007). They are consistent, in other words, with the conclusions about the underlying science that were unanimously accepted by representatives of the signatory nations of the United Nations Framework Convention on Climate Change who attended the IPCC plenary meeting in Paris two weeks ago:

a. Climate is changing faster than was anticipated only 5 years ago in the Third Assessment Report of the IPCC (2001); indeed, the signs of human-induced climate change are now being observed.

b. Significant climate impacts have been calibrated in terms of multiple metrics, and the thresholds of associated climate risk have been identified in terms of changes in global mean temperature; some of these metrics are economic, but many of them are not.

c. Many of the temperature thresholds for critical impacts are, regardless of the metric, now thought to be lower than anticipated only 5 years ago; it follows that we are approaching them more quickly than we thought, and so we will reach them sooner than we thought.

d. Achieving any concentration threshold cannot guarantee that we will be able to keep increases in global mean temperature below any specific target; in fact, achieving a concentration target can only reduce the likelihood of keeping temperature increases below any target at any point in time in the future.

e. Achieving any concentration threshold may, therefore, only delay inevitable increases in temperature unless persistent policy intervention over the entire century and perhaps beyond is undertaken.

Figure 2 in the Executive Summary of the *Stern Review* offers a concise portrait of the essential results of the most recent science. Temperature thresholds for key vulnerabilities are identified in many dimensions in the lower portion of the figure; their locations, in terms of warming, are the basis for believing that the debate over the science of whether or not there is climate risk is over. To be more precise, while none of these thresholds is known with certainty, it is now impossible to argue that *all* of them are completely implausible.

The imprecise links between temperature targets and concentration targets are meanwhile illustrated in the upper portion of *Stern's* summary figure when it shows that, for example, holding carbon-dioxide equivalent concentrations

a. below 750 ppm means a greater than 95% chance of exceeding 2 degrees (Centigrade) of warming above current levels and a 70% chance of exceeding 3 degrees of additional warming,

b. below 650 ppm means a 95% chance of exceeding 2 degrees and a 60% chance of exceeding 3 degrees,

c. below 550 ppm means around a 70%-80% chance of exceeding 2 degrees and a 50% chance of exceeding 3 degrees,

d. below 450 ppm means a 50% chance of exceeding 2 degrees and a 25% chance of exceeding 3 degrees, and

e. below 400 ppm means roughly a 30% chance of exceeding 2 degrees and still a 5% chance of exceeding 3 degrees.

While one may quibble about the precise numbers, their order of magnitude is not disputed. Putting the two parts of the figure together allows the reader to judge the sensitivity of our experiencing any specific risk to changes in policy. It is, indeed, a spectacularly powerful portrait of the predicament within which the current policy debate must be conducted.

It follows from its confirmation of the IPCC conclusions that the *Stern Review* makes the case that some sort of policy intervention, based on the economics of applied cost-benefit analysis couched in risk management terms, will be required. It is important to note, though, that it is impossible to write climate policy in 2007 that will be valid for the entire century. Coping with thresholds and uncertainty over the long term will require adopting an adaptive risk management approach where series of medium-term policy decisions will be informed by the evolution of long-term objectives. Designing such a program will be difficult, because it will need to give clear signals of intention over the medium-term even as it maintains sufficient flexibility for effective responses to changes in scientific understanding, changes in social valuations of impacts, and changes in our expectations of how the policies are working. In every case, however, this flexibility must somehow be immune to political and/or economic manipulation, and so designing such a mechanism will require a considerable amount of political leadership.[1]

2. Controversy about the Economic Estimates.

The *Stern Review's* estimates of economic damages and the cost of mitigation have been controversial within the economics research community in part because they are difficult to understand and in part because they are highly dependent on underlying assumptions about discounting, aversion to risk, aversion to inequality, and the valuation of non-economic metrics of impact and significant risk (abrupt change and extreme events, for example). Discussions about the estimates are fraught with detailed

[1] The Federal Reserve System of the United States is an example of an institution designed to accomplish all of these tasks. While surely in a different context, the Federal Reserve confronts the same sorts of short-term versus long-term tensions with the same sorts of price or quantity policy tools and protected from political manipulation by carefully designed insulation.

discussions of the technicalities involved in applying economic analysis to a complex problem like climate change. We highlight a few, here, but will shortly argue that the case for immediate action survives the controversy, especially if one takes a slightly different, but nonetheless economically rigorous tact. It is important to note in passing, however, that much of the controversy might have been avoided if the *Review* had been subject to a proper peer review before its release. This point was made by William Nordhaus at what was, in effect, a day long, public, and *ex post* peer review hosted by Yale University on February 15, 2007. The Stern author team admitted as much during that event, but they expressed concern that pre-publication review would have meant that bits of the *Review* would have been inappropriately leaked to the press.[2]

We begin our coverage of the controversy by noting simply that the Stern damage estimates are difficult to understand because they are expressed in terms of a "certainty equivalent and equity equivalent annuity" metric that converts expected discounted welfare values computed across thousands of possible futures and many countries into a single number. The analysis underlying the computation of this metric is sound, if not brilliant; see Mirrlees and Stern (1972) for the details of its development.[3] Its application to the climate problem is path-breaking, but it is vulnerable to the sort of misinterpretation that will make people roll their eyes and wonder if any of us know what we are talking about. The authors of the *Review* are careful to say that "total cost over the next two centuries…..*are equivalent* to an average reduction in global per capita consumption of at least 5%, now and forever" (our emphasis). When the results are reported in the popular press, however, the conditional phrase about equivalence is usually deleted, and that is a problem. Readers can react by saying "It's 'now', and I don't see my 5% reduction in consumption. Where is it? It's still 'now'! It's still not here!"

Notwithstanding this presentation problem, it is important to note that the damage estimates include not only the economic ramifications of climate impacts as they play out over time, but also a risk premium tied to the current level of uncertainty about the future as displayed in the simulation model. It is here that aversion to risk and aversion to inequality have an effect on the estimates. Weitzman (2007) argues that the *Stern* estimates undervalue these contributions because the tails of the distributions of our understanding of the climate impacts are so "thick"; in other words, the triangular representations of uncertainty (with their fixed limits) upon which the underlying simulations are conducted do not adequately consider the likelihood of extreme consequences. Yohe (2006) makes the point the risk premia included in the *Stern* estimates assume static distributions of scientific and economic parameters; as a result, they miss any potential that new knowledge and/or simple observations might reduce uncertainty and thus the willingness to pay over time. Dasgupta (2006) and Tol and

[2] This is a curious assertion. The *Stern Review* was reviewed by climate and impact experts. Peer review is typically done in strict confidentiality. An attempt by one of the current authors to obtain a copy of the *Stern Review* from a referee failed. Instead, he obtained a copy from a journalist, as the *Stern Review* was leaked to the press anyway.

[3] Note that Stern *et al.* (2006) do not calculate the balanced growth equivalent (as it claims) but rather the change in the balanced growth equivalent (Stern *et al.*, 2007).

Yohe (2007) also note an inherent inconsistency between the assumed aversion to risk (set at unity) and the assumed aversion to inequality (set at zero).

The damage estimates themselves have been criticized because they are based on a very low discount rate – a rate that virtually guaranteed high values. Dasgupta (2006), Maddison (2006), Nordhaus (2006), Tol (2006), Tol and Yohe (2006), Tol and Yohe (2007), Varian (2006), Yohe (2006) and Yohe and Tol (2007) all make this point. Some, like Nordhaus, argue that imposing such a low discount rate on investments to mitigate climate change in a world where other investments are required to earn higher returns is a prescription for the inefficient allocation of resources over time. Others argue that public investments can earn lower than market returns if they complement private investment; see for example, Ogura and Yohe (1977). The discount rate of HM Treasury is indeed below market, but above *Stern's.* Still others, including the *Stern Review* itself, make an ethical case for minimizing the rate at which impacts that will be felt by future generations are discounted in current policy deliberations.

In any case, as noted by William Nordhaus at the Yale event, it was incumbent on the authors of the *Review* to present the results of a sensitivity analysis spanning a range of possible utility discount rates in their primary publication. Choosing a discount rate does, indeed, lie in the purview of decision-makers, and it makes an enormous difference. A postscript released with far less fanfare two months after the *Review* does report the results of this sort of analysis, but it received almost no notice – too little, too late. The results are similar to ones reported in Tol and Yohe (2007) on the basis of a simple model calibrated to the *Stern* baseline scenario where damages create the equivalent of a 5.3% reduction in per capita consumption. There, lowering the rate further was shown to have very little effect on the estimate while increasing the discount rate to 3% would reduce damages to the equivalent of a 1.6% decline in equivalent per capita consumption. It should finally be noted that Weitzman (2007) expresses concern that the economic profession at large has not yet solved the problem of exactly how to discount the distant future when intergenerational transfers of wealth must be considered. His point is simple: there is a lot of fundamental work still to be done in this regard.

The damage estimates have also been criticized because they seem to have been calibrated to the high end of current understanding of impacts, because they sometimes miss the opportunity for adaptation especially in a future where incomes are expected to be higher, and because they add estimates of catastrophic damages to a baseline that already included estimates of the willingness to pay to avoid such calamity. Tol (2006), Tol and Yohe (2006) and Yohe and Tol (2007) have made these points. Tol and Yohe (2007) ultimately confront the "So what?" question by exploring the implications of assuming that the developing world's capacity to adapt will grow over time with their economic potential. To be specific, it is assumed there that developing countries' vulnerabilities to climate risks will have fallen to the current level assumed for the developed world by the time their economies have become as productive as today's developed world. The result is a reduction in discounted damages of more than 50%. Why so large for effects that happen so far in the future? Because the small discount rate rewards increases in future adaptive capacity as heavily as it punishes future impacts.

Mitigation costs are meanwhile estimated in terms of percentage losses in GDP, and so it is difficult to compare the costs of policy with its benefits (calibrated in terms of losses in equivalent per capita consumption). Mendelsohn (2006) has remarked that the mitigation cost estimates are too low and that some of the mitigation strategies are, when scaled up to the globe, infeasible. Others have noted that they seem to run only through 2050, and that they are not corrected for risk and inequality. Tol and Yohe (2006) wonder why the conventional 550 ppm concentration target from earlier UK work persists as a policy target when damage estimates are so much higher than before.[4] Perhaps most importantly, however, the *Review* never presents the net effect of mitigation in terms of the equivalent per capita consumption metric employed to track damages. Tol and Yohe (2007) have attempted to do so for a simple model calibrated, again, to support a 5.3% loss absent any intervention. They find that achieving a 550 ppm concentration target would reduce damages to 2.2%, that a achieving a 650 ppm target would reduce damages to 3.0%, and that achieving a 400 ppm target would reduce damages to 0.8%. These are not net benefit estimates, of course, because they do not include the cost of mitigation. They do show, however, that no amount of mitigation can be expected to eliminate economic harm expressed in terms of per capita consumption equivalents even though mitigation does reduce the uncertainty with which we view future impacts.

3. Implications for the Debate about Near-term Climate Policy.

It is essential that members of the policy-making community in the United Kingdom, in the United States, and around the world do not to fall into the trap of focusing all of their attention on the controversies that surround the specific estimates. To do so would mean that they run the risk of missing the most important message of the *Stern Review*. Decision-makers need to let the economic profession continue to work the technical details, but they cannot wait for resolution of the various controversies or analytical inadequacies before they begin to work on defining near-term policy in recognition of the long-term implications of climate risk identified in *Review.* They can do so by focusing on the growing proximity of those risks and by understanding the efficiency grounds for "buying insurance" against economic consequences of climate change and the economic consequences of rapidly ramping-up climate policy in the future. As soon they recognize that some sort of policy will be required (and that recognition follows directly from *Stern's* summary figure described above), simple economics says that taking the least cost approach means starting now.

This conclusion is true in large measure because atmospheric concentrations of greenhouse gases depend on cumulative emissions over time. As a result, achieving any targeted concentration limit (and thus a corresponding range of possible temperature increases and associated climate risks) is fundamentally an exhaustible resource problem.

[4] There is another puzzle. The *Stern Review* has higher damages and lower costs than previous cost-benefit analysis in the UK (e.g., Clarkson and Deyes, 2002), yet recommends the same targets for emissions and concentrations. When the Cabinet decided that UK climate policy should not be intensified as a result of his work, Nick Stern resigned.

The long-standing Hotelling result therefore applies, at least to a first approximation: to maximize the discounted value of welfare derived from an exhaustible resource (that is, to minimize the discounted costs of limiting cumulative emissions over the long-term), simply calculate the appropriate initial "scarcity rent" (in this case, an initial price for carbon) and let it increase over time at the rate of interest.[5] To be more specific, the Hotelling result means that it is enough to specify an initial price of carbon (or perhaps setting targeted permit price for a cap and trade system). This price should be designed to get the attention of the business community and to show political leadership in the face of a serious problem. It need not, however, be set so high that it would cause undue economic harm in the short-run. Allowing the carbon price to increase at the rate of interest year after year (following Hotelling) and acknowledging that adjustments for new knowledge about performance and risk will have to be accommodated over time will give the policy traction.

Adjustments over time in the concentration target (borne of uncertainty about the climate system specifically and the future more generally) confound the issue, to be sure, but Yohe, et al. (2004) show that some hedging based on the Hotelling result minimizes expected costs even if there is a chance that we will discover sometime in the future that the climate problem fixes itself and climate policy initiated now was unnecessary. Why? Because the expected costs of adjusting to more pessimistic climate news sometime in the future if we delay taking action are higher than the expected costs of doing too much too soon (even with discounting at the market rate of interest).

4. Designing a Near-term Policy

Setting the initial scarcity rent for carbon can be an exercise in determining the appropriate short-term incentives for carbon-saving investments and energy conservation rather than an exercise in "solving the climate problem". Since no policy created in 2007 will "solve the climate problem", it is perhaps even desirable to step out from under that burden to confront a more manageable near-term problem while still making progress towards an ultimate response to an evolving understanding of climate risk. The answer to "What to do in the near-term?" is to design something that will (1) discourage long-term investments in energy, transportation, and construction that would lock in high carbon intensities for decades to come and (2) encourage development of alternative energy sources, carbon sequestration technologies and efficiency.

As an example of how the first goal might be achieved, one might consider what it would take to make it economic to simply run existing natural gas-fired electric generators more, and run coal-fired generators correspondingly less (gas-fired generators emit only about half as much CO_2 per unit of electricity). Because natural gas is a considerably more expensive fuel than coal, it takes a substantial CO_2 cost to overcome this fuel cost disadvantage – about $30/ton, on current fuel price expectations in the U.S. On the other hand, consider pending investments to add new generating capacity in the

[5] Note that the emission reduction trajectory in the *Stern Review* violates this basic principle; indeed, the price of carbon falls over time.

United States over the next few decades. Much of this capacity is currently planned as conventional coal-fired technology. What would it take, in terms of CO_2 price, to make it economic to install new gas-fired capacity instead, thereby cutting by half the carbon emissions from this new capacity? On current gas price expectations, a CO_2 price of only $5 per ton would be sufficient to make new gas-fired generators as economical as new coal-fired plants, based on the present value of fixed and variable costs. This number is much lower for new plants than the $30/ton seen above for existing plants because the lower cost of building a new gas plant compensates for some of its higher fuel cost. Several factors may necessitate a somewhat higher CO_2 price to achieve this economic equivalence, however – e.g., greater fuel price volatility makes gas capacity relatively less attractive and increased gas demand might push up gas prices beyond current expectations. Even so, only a modest CO_2 price is needed to make lower-carbon gas-fired technologies attractive.

To make the full step to near zero carbon technologies (e.g., carbon capture and sequestration) would require a somewhat higher CO2 price – estimated at around $25/ton CO_2 by several sources and included in Pacala and Socolow (2004) as one possible "wedge" of emissions reduction. But even so, since power generators last 30 to 40 years, if the CO_2 price increases over time, as Hotelling suggests, it can make CCS technologies attractive even if it does not reach this "tipping point" until some years after the new plant starts operating.

The $7 per ton of carbon dioxide charge envisioned in the legislation being considered by the Energy and Natural Resources Committee of the U.S. Senate would, if it were to climb at the rate of interest, reach $30 per ton after 2035 – probably too late to inspire fuel switching in existing plants over the foreseeable future or much investment in carbon sequestration; but it would likely be sufficient to bring most of the plants constructed between now and 2050 over to a lower carbon technology. A $15 per ton charge in 2007 would reach the $30 threshold around 2020, though, and that could be sufficient to affect the retrofitting switch in most places in the very near future and inspire appropriate development of enhanced sequestration techniques.

To shift investments in new infrastructure toward lower or zero carbon technologies, then, it is necessary for a climate policy to create a CO_2 price. It must also create confidence that within the relatively long planning horizon of such infrastructure, the CO_2 price will reach and maintain levels that will make the lower carbon technologies economic, but those price levels are readily achievable with a realistic policy. It is important to note that the meta-analysis of Tol (2005) suggests that $15 per ton is not an unreasonable estimate of the marginal damage costs of current carbon dioxide emissions. What would that cost in the economy? A $15 per ton charge would add almost $6 to a barrel of oil. We have recently seen monthly variation in oil prices bigger than that; the difference here is that it would be predictable, and it would affect different fossil fuels differently. It would add 14 cents to a gallon of gasoline. Given current fuel configurations for electricity generation in the United States, it would increase electric bills by about 15% of the retail price, on average (and this effect would diminish as lower carbon technologies are installed over time).

5. In Support of Taxation as an Alternative to Cap and Trade.

Cap and trade systems have become the stock in trade of many who try to advocate climate policy, but this preference may be based on little more than an allergic reaction to the use of the word "tax". Since concentrations depend on cumulative emissions over long periods of time, there is no Weitzman (1974) reason to favor a policy that would fix annual emissions in a way that otherwise minimizes the cost of hitting such a target. Yohe (1992) noted, more specifically, that fixing total emissions of any pollutant only makes sense if period-to-period variability around a targeted mean (that would improve economic efficiency) would unnecessarily increase expected social costs; and he argued that this is clearly not the case for carbon emissions. In addition, Newell, et al. (2004), among others, have expressed concerns that the prices which clear cap and trade permit markets can be volatile. Volatility has certainly been the hallmark of the sulfur permit markets in the United States and the nascent carbon markets of the European Union. Pizer (2002) responded to threat of incapacitating volatility by proposing "safety valve" limits on the price of permits. Others have argued that volatility can be diminished by appropriate banking provisions. The fundamental problem with either solution, however, is that appropriate climate policy requires a clear signal that carbon will always be more expensive next year than it is today. Even a modest amount of volatility can obscure that signal.

On other hand, a tax, increasing at the rate of interest a la Hotelling, would produce a persistent and predictable increase in the cost of using carbon that would inspire cost-reducing innovation and fuel switching in the transportation, building, and energy supply sectors of our economy.[6] If carbon were taxed at the point it entered an economy (a couple thousand sources for the United States as opposed to millions of end-users), then it would be dispersed appropriately throughout the economy with relative prices of thousands of goods changing in proportion to the underlying carbon intensities. Moreover, it would generate revenue. The $15 per ton of carbon dioxide tax noted above would, for example, generate something like $90 billion in tax revenue in the United States in 2007 if it were paid on every ton of carbon embodied in every unit of fossil fuel consumed. This is revenue that could be used to offset the regressive nature of the carbon tax itself, by underwriting tax credits for citizens with taxable incomes below a specified level. The substitution effect would still apply, of course, so carbon conservation could be expected even from the beneficiaries of the credits. Tax revenue could also be used to reduce other distortionary taxes. It could even be used to fund research into alternative energy sources.

A carbon tax would not, of course, provide any incentive to sequester carbon, but that can also be accomplished by appropriate use of some of the tax revenue. Yohe (1989) describes how some of the revenue might be used to "buy back" carbon that was removed from the end of the effluent stream at a price that equals the tax applied at the

[6] The tax should increase, in real terms, at the real rate of interest. If expressed in nominal terms, then it should increase at the nominal rate of interest.

beginning. Doing so would mean that the marginal cost of bringing in the last ton would equal the marginal cost of taking it out – an efficiency criterion that "closes the loop". Interestingly, a $25-30 per ton of carbon dioxide has been identified as the level for which current sequestration technologies might become economically efficient. McCarl and Sands (2007), for example, estimate that annual terrestrial offsets alone could total between 1 and 1.2 billion tons of carbon dioxide between 2010 and 2035 if a $30 per ton value were assigned to carbon dioxide. Some of the detail behind estimates of this sort has been offered by Antle, et al. (2007). They show carbon sequestration supply curves for conservation tillage in the agricultural heartland of the United states that begin at carbon dioxide prices that range between $5 and $10 per ton and reach capacity thresholds between $30 and $50 per ton. Bringing these technologies up to scale would take more than a decade, of course, and large investment would be based on the same type of present value calculation outlined above. It follows that the same tax trajectory that starts at $15 per ton in 2007 and reaches the $30 threshold around 2021 would also serve well in this context.

6. Conclusions and Discussion.

We reach the same conclusion as Weitzman (2007); the *Stern Review* is right for the wrong reasons. The economics of climate policy *do* support the conclusion that it is time to act – not because the underlying science of impacts born of anthropogenic sources is not fraught with uncertainty, but because claims that the climate is not changing are now indefensible. Greenhouse gas emissions should be reduced as a hedge against the possibility of significant climate impacts *and* against the risk of expensive policy adjustments if nothing is done immediately. These reductions will best be achieved by a price signal that is relatively low today but is guaranteed to rise in a persistent and predictable way. Quite remarkably, we expect that few economists would disagree with this conclusion.

The fact that the *Stern Review* is right for the wrong reason *does* matter though. It makes the *Review* an easy target for those want argue against immediate action. The *Review* can even be used as a weapon by those who want to claim that the climate is not changing (or at least that humans are not to blame). Moreover, its shortcomings have forced Stern's colleagues to publicly defend the integrity and competence of the economics profession and the application of economic analysis to the climate problem.

The innovative forms of abuse concocted by some of the smartest economists on the planet have entertained some. Leonardt (2007), for example, began his coverage of the public peer review session at Yale ("an academic fight that really matters" in his words) with the observation that "The economics profession is engaged in one of those (fights) right now and, as luck would have it, it's even more entertaining than most". That is fine, of course, but the message "Stern is wrong but right nonetheless" must be confusing to most – and unnecessarily so.

The *Stern Review* and the Fourth Assessment Report of the IPCC together seem to have silenced the public debate on the reality of the risks of climate change. We do not know which contributed more, but the *Stern Review* clearly put the economics of climate change in the public attention. On the one hand, this is a good thing. Economists have a technocratic streak, and public scrutiny of their policy advice is absolutely necessary (Funtowicz and Ravetz, 1994; Funtowicz *et al.*, 1998). On the other hand, successful emission reduction will require a global, century-long effort. The *Stern Review* enflamed rather than enlightened the discussion from which the effort will emerge. Where consensus is needed, controversy was flamed. This was true for the immediate aftermath of the publication of the *Stern Review*, and it may still be true. Let us hope that this is not the case for the future. Let us hope that Leonardt's (2007) final observation from his day at Yale carries the day now that the dust is settling: "In other words, it's time for a tax on carbon emissions".

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