The Economics Underlying U.S. Climate Policy Choices

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Abstract

Under the most reasonable assumptions, the costs and risks of not acting to stabilize atmospheric greenhouse gas concentrations at safe levels will greatly exceed the costs of doing so. Government policies should insure against the uncertain possibilities of catastrophic damages if the climate is not stabilized.

Because climate stabilization policies must be sustained for decades, it is crucial that they be both effective and economically efficient. The economic impacts of reducing greenhouse gas emissions, if done wisely, will amount only to a minor and possibly undetectable reduction in futures rate of economic growth, consumption, and employment. Though energy prices will rise, macroeconomic impacts on trade and industry will be small. These impacts can be managed most effectively through cooperative efforts among our major trading and investment partners.

Emissions can best be reduced by placing an economy-wide price on the sale and combustion uses of fossil fuels. This can be done either by enacting a tax on the sale of fossil fuels, or by enacting a upstream cap-and-trade system requiring permits for the initial sale of fossil fuels in the U.S. economy. Uncertainty regarding the appropriate carbon price argues for a cap-and-trade system as the preferable policy approach, in order to eliminate the risk that climate change will be excessive. Such a system could incorporate a safety valve feature to prevent the carbon price from becoming too high. Under a cap-and-trade system, the economic consequences will be significantly improved if the permits are auctioned and the revenues are used to reduce other tax rates that distort economic decisions.

The additional benefits such a policy would confer on the economy include lessened dependency on imported oil, greater energy security, and reduced health and economic damages from air pollution.

The growing threat of climate change, closely linked to the challenges of energy insecurity and increasing dependency on imported oil, demands a vigorous, coherent and comprehensive response. The needed response will produce an energy transition over the next half century toward much improved energy efficiency in all sectors and much greater reliance on non-fossil energy sources. The effects of such a transition on the U.S. economy are a subject of controversy. Clearly, good policy choices are needed to minimize costs and maximize benefits.

One of the most searching examinations of this issue, the *Stern Review on the Economics of Climate Change*, prepared for the British Prime Minister and Chancellor of the Exchequer, concluded that the costs of inaction would be several times the cost of taking action to stabilize greenhouse gas concentrations at relatively safe levels. The costs of inaction would take the form of higher and ultimately catastrophic future damages from climate change, as well as growing energy insecurity.

Other analyses have questioned whether such a fundamental transition can be brought about in the current energy system without significant losses in income, production and employment that potentially exceed the damages from climate change itself. These analyses, however, typically rest on several critical but largely invalid assumptions. The first of these is that climate change will take the form of a gradual and largely predictable increase in average temperatures and gradual changes in average precipitation, to which the economy will adjust. However, the risks of increasingly damaging consequences rise sharply as greenhouse gas concentrations rise. Even if average temperatures rise gradually, this change will increase the frequency and intensity of extreme weather events, including hurricanes, flooding, droughts and heat waves. It is these extreme weather events that will be responsible for most of the damages from climate change, because both natural and man-made systems have a limited range of tolerance for weather extremes. Within those limits, crops, animals, and man-made infrastructure can withstand weather variations, but when extreme weather exceeds those limits of tolerance, damage can be severe and extensive, as recent hurricanes and floods have demonstrated. Almost no macroeconomic models used in the debate take these potential catastrophes adequately into account.

A related invalid assumption is that the American economy, with ample technological, human and financial resources, will employ foresight to adapt to future climate change in ways that minimize damages. Most economic models incorporating climate change damages assume that households and businesses will do what they can reasonably do to limit those damages, without further policy stimulus. Because the probability of extreme and relatively infrequent weather events is hard to estimate, however, adaptations are more likely to be made in the aftermath of damaging events than in anticipation of them.

The American economy has already experienced four decades of measured climate change. Temperatures have risen by more then two degrees

Fahrenheit, the intensity of hurricanes has increased, and a larger percentage of rainfall is falling in severe storms. Yet, studies have shown that few organizations that are vulnerable to damages, whether public or private, have taken concrete preventive steps. Such evidence indicates that adaptation, at best, will be slow and belated. Nor will the U.S. economy be insulated from the damages that affect other countries, especially in the developing world. Economic failures elsewhere will affect US companies. Weather catastrophes will increase the flow of refugees and migrants and cause political instability in critical regions. Such interdependencies will only increase in the 21st century.

The most important point of disagreement among competing economic views on climate change has been about the right discount rate to use in valuing costs and benefits occurring in future decades. Since climate effects will extend over centuries, the size of the discount rate largely determines the outcome of any cost-benefit analysis. Some economists argue that decisions on climate policy should be guided by the rate of return on investments, about 5 or 6 percent per year, on the grounds that investing money now, rather than spending it to reduce emissions, will create wealth that could be used in the future to adapt to climate change or compensate for damages. Discounting future damages at such a rate gives very little weight to future impacts. It would be worth only 25 or 30 cents today to prevent a dollar of damages suffered in 2035 and only pennies to prevent damages at the end of the century.

However, the private rate of return on investment is an inappropriate basis for climate policy decisions. Private rates differ fundamentally from societal rates of return because private investors typically don't bear all the costs of their investments. Environmental damages, for example, are not taken into account when coal-fired power plants are built. Those damages are borne by society as a whole.

The decision to spend now to prevent damages that will largely affect future generations is intrinsically an ethical decision. For the most part, those who pay such costs today will not themselves receive the benefits 50 years from now. Yet economic models assess such ethical judgments on the basis of an individual's willingness to delay gratification. They do not address the valuation of a future person's welfare relative to that of a current person's. More fundamentally, these parameters cannot be evaluated properly by an economic model. People differ widely in their value judgments, and there is no market mechanism through which these judgments are brought into line. They must be faced directly.

Central to these policy decisions is the chain of uncertainties about the long-term consequences of climate change. The possibility of truly catastrophic damages cannot be ruled out. Most analyses ignore such catastrophic outcomes because their probabilities are regarded as very small, but it is impossible to know how small. The chance of catastrophic climate change occurring may be only 5 percent, but if an asteroid were approaching Earth with only a 5 percent chance of obliterating the planet, society surely would mobilize to destroy or deflect it.

Indeed, the greater the uncertainty and the more serious the possible worst-case outcomes, the more should reducing that probability dominate policy decisions. If national policy seeks to mitigate serious risks, as it does, for example, in matters of national defense, health care, and retirement, then it is equally worthwhile to insure against serious future climate change damages. In this sense, decisions about climate policy are more like those about social insurance than about investing resources now to save money later. Reducing emissions prevents future damages and also reduces the likelihood of truly disastrous long-term outcomes.

These observations suggest that for the U.S. economy the long-term costs of inaction, giving appropriate consideration to the risks of catastrophe, will greatly exceed the costs of action to stabilize climate. Addressing those risks need not be economically punitive. If designed and carried out wisely, climate response strategies can raise living standards, stimulate investment and job creation, and reduce risks to the national economy.

In order to hold atmospheric greenhouse gas emissions to a tolerable level, U.S emissions must fall by at least 70 percent over the next half century. Other developed country emissions must also decline along a similar trajectory, and emissions from large developing countries must begin to decline no later than 2025. International cooperation in stabilizing the global climate is essential.

For the United States, the essential first step is to limit emissions of carbon dioxide from fossil fuel combustion, and on as many other heat-trapping gases as possible, by establishing a price for polluting. Such a price would reflect the environmental damages that these emissions cause and provide economic incentives for emitters to improve the efficiency of their energy use and to find alternative energy sources. As these carbon prices become embodied in energy prices and the costs of energy-using goods and processes, all other decision-makers in the economy would be motivated to economize on the use of fossil energy, both directly and indirectly, and to bring energy alternatives to the marketplace. The economy-wide carbon price needed to accomplish this transformation would increase steadily in inflation-adjusted terms for decades. This gradual phase-in would allow the economy time to adjust with minimal disruption.

Estimates of the price needed by 2030 range from $20 per ton of carbon dioxide equivalents to more than $150 per ton. The estimates for 2050 range from $60 to $250 per ton. Why are these price estimates so divergent? First of all, uncertainty arises about the availability of important technological options, such as new nuclear power plants, and the feasibility of sequestering large volumes of carbon dioxide from coal-fired power plants underground. A second important source of uncertainty is whether energy and power companies will be allowed to reduce their emissions indirectly by paying for lower-cost reductions in other countries or through carbon-conserving changes in agricultural and forestry operations. A third uncertainty concerns the future of energy prices. Should market prices be high because of rising supply costs and growing energy demand in rapidly growing developing countries, less additional economic incentive will be needed to induce higher energy efficiency and a transition to non-fossil fuels. Should market prices for fossil energy be low, greater reliance on an explicit price for carbon emissions would be needed.

There are other sources of uncertainty as well. In recent years, federal, state, and local governments have enacted mandates and incentives to promote energy efficiency and the use of renewable energy. Tax credits, subsidized loan programs, and direct government spending have been adopted to boost the market. Renewable portfolio standards and other requirements have been enacted to accelerate change in energy sources. The more effective these policies are, the lower carbon prices will need to be to reach the emission reduction targets. Similarly, the more responsive consumers, businesses and investors are to economic signals, the lower the carbon price will be. Despite fears that consumers are loath to change their accustomed energy use patterns, higher gas prices caused discernible shifts in automobile purchases. Corporations have taken increased interest in improving their energy efficiency, and investors have been pouring money into new renewable energy and other "clean tech" ventures. If this pattern continues to be strong in response to an economy-wide carbon price, then the needed price will be lower than it would be if the response were sluggish.

There are basically two ways in which an economy-wide price on carbon can be established, and the uncertainties described above affect the choice between them. One way would be to impose a carbon tax on all fossil fuels in proportion to their carbon content. Taxes would be collected on sales of domestic and imported fuels alike. The tax on coal would be highest, about twice as high as the tax on natural gas, reflecting coal's higher carbon content per unit of energy content. The tax would be collected from the roughly 2,000 primary sellers of fossil fuels. To some extent, the tax on coal would be absorbed by the shareholders of coal mining companies, since there are few alternative uses for a coal mining property. To the extent that U.S. demand for petroleum is reduced by the tax, it would also cause a marginal reduction in world oil prices below their pre-tax levels, since the United States is a very significant consumer of petroleum. For the most part, however, the tax would be reflected in higher fuel prices charged to consumers, and in this way would work its way throughout the economy. Taxes on sales of fossil fuels for purposes other than combustion, such as for chemical feedstocks, would be rebated, since those uses don't result in emissions. Tax credits would be granted in return for "offsets" of emissions, on a ton-for-ton basis, to the extent that domestic and international offsets are allowed.

The alternative would be to adopt an upstream cap-and-trade system for the sale of fossil fuels. Under this policy, the same 2000 sellers would have to hold permits issued by the federal government, denominated in tons of carbon, for all the embodied carbon contained in the fuels they sell. These permits would be tradable among sellers and, presumably, among traders, fossil fuel users, speculators, and other participants in the permit market.

Making permits tradable would not only lead to a uniform carbon permit price but would also ensure that the sales of fossil fuels with the highest economic value take place, since those sales would be able to bid the highest prices for permits. The number of permits issued by the government would decline year-by-year to achieve the necessary reduction in carbon emissions, and prices would increase. To even out permit price fluctuations over time, permit holders would be able to borrow, lend, and bank permits from year to year. Just as with a carbon tax, sales of products such as chemical feedstock would not require permits, and sellers of "offsets" would earn permits that could be traded on the permit market.

Conceptually, an upstream cap-and-trade system on fossil fuels and a carbon tax would result in quite similar economy-wide carbon prices if they achieved the same emission reductions. However, the wide range of uncertainty about what that carbon price would be creates an important difference between them. Since a reduction in emissions over decades is required, a carbon tax regime would have to specify its price trajectory in advance in the legislation, or authorize annual adjustments in the tax rate by a government agency. The uncertainty and potential volatility in carbon prices and price trajectories that might be needed make either possibility difficult. Annual adjustments in tax rates are difficult in a politically charged setting, and the price effects of any tax on energy markets and the broader economy take years to manifest themselves, making appropriate short-term adjustments even more difficult.

The upstream cap-and-trade approach establishes the required emission reduction trajectory directly, letting market forces establish the resulting carbon price, whether high or low. If the major sources of price uncertainty resolve themselves favorably, the price will be low; if unfavorably, the price will be high. In either case, emissions will decline in accordance with the established trajectory. Therefore, uncertainty poses a choice between competing risks: whether the most important danger is that a carbon tax will be set too low, resulting in emissions that are too large to stabilize the climate at a tolerable level; or whether an emissions reduction schedule will be too stringent, resulting in a carbon price that damages the economy. A carbon tax offers certainty about price but is an inherently inefficient way to reduce emissions, as policy makers can only guess at its impact; a cap-and-trade system offers less price certainty but more assurance that the emissions target will be reached in an economically efficient way.

To alleviate price risk, some economists have proposed modifying a cap-and-trade system with a price ceiling at which the government would supply additional permits to the market, preventing further price increases. At the price ceiling, the system would behave like a carbon tax, in that additional permits could be obtained at a fixed price. Some economists have also proposed a price floor, at which price government would buy permits from the market, preventing further price declines. In effect, these modifications would change the established emission reduction trajectory if its cost seemed "too" high and tighten it if the cost appeared “too” low. Unfortunately, there is no objective method by which to make these judgments, and either would exact a price in economic efficiency.

Both approaches would yield quite substantial revenues to the federal treasury – $100-200 billion per year in 2015, rising to $200-300 billion by 2030. These revenues could be used for a number of useful purposes, or for less useful purposes. They could be used to offset economic impacts by reducing other tax rates, especially of highly distorting taxes that impose large deadweight losses on the economy. They could be used to compensate low-income households for their increased energy costs through increases in the earned income tax credits or other refundable tax credits. They could be used to fund research and development of high-priority energy technologies, such as carbon capture and sequestration. They could be used to help finance high-priority energy infrastructure investments, such as new transmission lines to bring wind and solar energy to market.

To what extent the economic impacts of a carbon tax could be ameliorated by reductions in other tax rates is a matter of considerable economic debate, driven by questions about which other tax rates would be reduced, how great their distorting effects are, and how a carbon tax would interact with existing taxes through effects on consumer costs of living and investor returns on new investments. Nonetheless, there is general agreement that such revenue recycling could offset a major portion of the economic impacts of a carbon tax and perhaps all of them, creating a so-called “double dividend.” The first dividend would be the reduction of greenhouse gas emissions, avoiding damage from climate change; the second dividend would be a more efficient tax structure, replacing a more distorting tax with a less distorting carbon tax. Many economic analyses – but not all – have concluded that a broad-based tax on fossil fuels would not have as large a distorting effect on economic activity as other some taxes already in the system, which are riddled with exemptions, deductions and other special provisions that invite efforts at tax avoidance.

Existing cap-and-trade systems, such as those regulating atmospheric sulfur and nitrogen emissions, have not involved complete auctioning of permits, however, nor has the European Union’s carbon dioxide permit trading system. Instead, most or all of the permits have initially been awarded free of charge to those required to hold permits. This approach raises the economic impacts of such cap-and-trade systems by forgoing opportunities for revenue recycling through the tax system. It has also makes the system more unfair to lower-income households, since valuable assets are given freely to companies, largely to the benefit of shareholders, while the higher costs are passed along, mainly to consumers.

Under any of these policy options, energy prices would rise for households and enterprises to an extent determined mainly by the permit price, which will be reflected in fossil fuel and electricity prices. According to an analysis by the Energy Information Administration of legislation considered last year by the U.S. Senate, retail electricity prices might be 5 to 11 percent higher in 2030 than they would be without a federal climate policy, mainly because of higher coal costs. That amounts to an average increase of less than a penny per kilowatt hour, though the increase would differ from region to region.

Other energy prices would also be affected, of course. According to an EPA analysis, the cost of a barrel of oil might be $26 higher than otherwise, and consequently drivers might pay an additional $0.53 for a gallon of gasoline. These increases are by no means insignificant and largely determine the economic impacts that would be felt throughout the economy; however, the scale of such increases is considerably smaller than the short-term changes felt by the economy in 2008 alone, and a cap-and-trade system or carbon tax would bring them about gradually over a 20-year period. One would expect, therefore, that their economic impacts would be milder.

Economic analyses confirm this expectation. The rate of growth of gross domestic product (GDP) and personal consumption would be only marginally affected. For example, simulations by the two macroeconomic models used by EPA estimate that the long-term average annual growth rate of personal consumption in the United States would decline from 2.75 percent per year to 2.69 percent in one model and from 2.69 percent per year to 2.52 percent in the other model. These small differences, from 2 to 5 percent of the base figures, are well within the forecasting errors of all macroeconomic models. If such small differences were maintained over long periods of time, however, they would result in appreciable differences in the size of the economy: GDP by 2050 would be 1.6 percent lower by 2050 than it would otherwise be, according to one model, and 6 percent lower, according to the other. Nonetheless, the level of real income and consumption in the United States would still be nearly twice as high in 2030 as in 2010 and nearly four times as high by 2050. All serious economic analyses agree that establishing a national carbon price would not prevent robust economic growth.

Some economic benefits would also materialize that are not now fully measured in the national economic accounts. For example, the shift away from coal and the rising use of non-fossil energy sources would significantly improve air quality and reduce air pollution control costs. Many old, inefficient coal-fired power plants would be retired and replaced because they could not justify the cost of carbon permits. Retiring these plants would reduce emissions of mercury, particulates, and other pollutants and would greatly lower the costs of maintaining air quality standards for sulfur and nitrogen oxides and ozone. When the benefits of fewer premature deaths and disabilities and lower rates of respiratory illness are taken into account, economists have estimated that the economic impacts of a national climate policy are improved by almost half.

Another important economic benefit would be the reduced dependence on imported oil that would result from a national carbon price. Oil imports are responsible for the transfer of several hundred billions of dollars per year to foreign oil companies, many of them controlled by foreign governments that are not particularly friendly to the

United States. Oil imports account for a significant share of our balance of payments deficit, which has caused a decline in the purchasing power of the dollar and an enormous build-up of national debt in the hands of foreign banks, putting limits on our monetary policy options. Indirectly, because of the need to protect oil imports from the Middle East, this dependence has also affected military spending and the national budgetary deficit. One result of a national carbon price, operating through a shift toward domestic renewable energy sources and improved energy efficiency, would be to reduce oil import dependence and improve these indirect economic impacts.

Moreover, petroleum and coal face inevitable long-term resource constraints. New petroleum supplies, which once were found seeping out of the ground, can now be obtained only by drilling more than a mile under the ocean or in the remote Arctic. Coal mining in this country, which first exploited the most accessible deposits, now involves the removal of hundreds of feet more of overburden to reach the coal. Almost inevitably, fossil fuel prices will continue their long-run rise. By contrast, renewable energy costs are on a downward long-term path because the constraints are technological limitations that are subject to improvement. Already, costs of solar and wind power have dropped by 90 percent over the past two or three decades and will continue to decline as technological developments now under way are implemented.

If a long-term, gradually rising carbon price is put in place, especially if accompanied by a gradual reduction in the availability of fossil fuels, technological improvements already under way almost certainly will accelerate as entrepreneurs develop and venture capitalists finance a widening stream of innovations to lower the cost of renewable energy options and to develop new cost-effective ways to improve energy efficiency. The more rapid and extensive this induced technological change, the more favorable will be the economic impacts.

An energy transition to reduce dependence on carbon fuels would create, on balance, hundreds of thousands of new jobs through sectoral shifts, even though macroeconomic effects would be small. Coal mining, oil and gas extraction, and central power plant electricity generation are highly capital-intensive but employ relatively few workers per unit of output. By comparison, the production of biofuels, the production and installation of solar energy, the construction or retrofitting of buildings for greater energy efficiency, and the manufacture and sale of devices to raise energy efficiency are much more labor-intensive. Moreover, a large percentage of these jobs – in construction, installation, servicing, and maintenance – would by nature be domestic and not open to outsourcing overseas.

The effects on international trade and investment are complex and depend both on other countries' carbon policies and on the structure of U.S. policy. Much concern has been expressed over possible migration of U.S. industry to countries with lower energy costs. That concern is exaggerated, for two reasons. The first is that energy is a significant cost element only in a relatively small segment of manufacturing: metals, pulp and paper, primary chemicals, and cement. Most industrial migration to China and other developing countries has been for the purpose of exploiting differences in labor costs, not energy costs. Energy efficiency in these industries in China, India, and other major developing countries is significantly lower than in the United States, an energy cost disadvantage. Moreover, imports from those countries are concentrated in such labor-intensive industries as apparel, leather goods, electronics, furniture and housewares and the like.

The second reason is that our main trading partners in Europe, Canada, and Japan ratified the Kyoto Protocol and have already initiated policies to establish a carbon price in their own economies. They have pledged to intensify their efforts if the United States adopts mandatory emission limitations. China, as well, has adopted ambitious targets to reduce energy intensity of production and strong implementing measures. Negotiations with the large developing countries, including China, India, and Mexico, over the next phase of international cooperation after 2012 will be critical. If those countries agree to adopt further measures to limit carbon emissions, contingent on the U.S. doing so, then the issue of leakage and industrial flight will be largely eliminated.

There have been proposals to impose tariff duties on imports from countries that do not adopt policies to limit emissions, in order to offset any cost advantage they might derive from less expensive fossil energy. Aside from the difficulties in estimating the amount of fossil energy used directly and indirectly in making the myriad goods entering international trade, as well as the potential trade disputes brought to the World Trade Organization if unilateral attempts are made to discriminate among imports of the same goods on the basis of their method of production, it would probably be more effective to use "carrots" rather than "sticks" to promote international cooperation. Emerging market countries would benefit from access to international carbon offset markets, if made conditional on their cooperation, and would also benefit from technology and research sharing agreements. Such incentives have the virtue of benefiting both the recipient and the countries offering them.

Other effects on our international accounts will be mixed. Rising energy costs that increase production costs will make exports in those industries less competitive, but a slower rate of economic growth will reduce import demands, with an offsetting effect on the balance of trade. If national climate policy allows an unlimited purchase of international offsets, there may be a significant outflow of capital. This would tend to depress the dollar exchange rate, further discouraging imports and encouraging exports. However, a substantial reduction in petroleum imports would have the opposite effect, raising the dollar exchange rate. The net effect of all these changes is difficult to predict, but is likely to be small.

To recapitulate the main points:

- Under reasonable assumptions, the costs of not acting to stabilize atmospheric greenhouse gas concentrations at safe levels are likely to exceed greatly the costs of doing so.

- The economic impacts of reducing greenhouse gas emissions, if done wisely, will amount only to a minor and possibly undetectable reduction in future rates of economic growth, consumption and employment.
- Emissions can best be reduced by placing an economy-wide price on the sale and combustion of fossil fuels. This can be done either by enacting a tax on the sale of fossil fuels, or by establishing a cap-and-trade system requiring permits for the initial sale of fossil fuels in the U.S. economy.
- Uncertainty regarding the appropriate carbon price argues for a cap-and-trade system as the preferable policy approach, in order to eliminate the risk that climate change emissions will stay too high.
- The additional benefits such a policy would confer on the economy include lessened dependence on imported oil, greater energy security, and reduced health and economic damages from air pollution.
- Under a cap-and-trade system, the economic consequences will be significantly improved if the permits are auctioned and the revenues are used to reduce other tax rates that distort economic decisions. The same would be true if revenues from a carbon tax are returned to the economy in this way.

Dealing with the climate issue is likely to be the greatest global challenge of the 21st century. Whether or not the United States rises to that challenge depends not on our economic or technological capabilities but on our ability to generate political leadership and a national commitment – each of them dependent on the perceived impact of action on the U.S. economy. With good policy choices the net effects are likely to be small and may well be positive.