Economics and Political Climate Policy

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It its 2018 special report, the IPCC calls for rapid cuts to CO_2 emissions by 2030 in order to reduce the impacts of global warming. This essay will discuss two areas of focus for policy makers, and how these policy changes could speed up sustainability transitions. The first part of this essay will discuss the IPPC report, focusing on the call for CO_2 reduction. Part two will address economic policies and argue for a shared social cost of carbon (SCC). I will also argue that targeting demand side policies first and then following up with supply side policies will have a greater impact on CO_2 emission reduction. This section will include an example from the Norwegian electric vehicle policy to show a successful demand side policy implementation coupled with a reduction in oil production. That will be followed with recommendations for introducing policies that increase the dissemination of information globally. Compared with other pollutants, CO_2 is considered an externality; CO_2 disperses globally and remains in the in the atmosphere for millennia. For these reasons a successful control strategy needs to involve a combination of local policies that unite to form an aggregate global strategy.

The 2018 IPCC Special Report highlights “the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways” (IPCC 2018, p. 4). The report lists findings based on scientific, technical and socio-economic data, provides level of confidence indicators associated with key findings and identifies knowledge gaps in the research literature (IPCC 2018). The primary sections, listed in the Summery for Policy Makers (SPM), include data for understanding global warming, the potential impacts and risks associated with projected climate change, emission pathways and system transitions that could maintain global temperatures below the 1.5°C level and ways to strengthen the global response involving sustainable development and efforts to eliminate poverty (IPCC 2018). This essay is a response to the IPCC report and lists several economic and political policy recommendations that could speed up sustainability transitions.

The first of two policy recommendations are in the field of economics and concern carbon taxation and the social cost of carbon (SCC). Conversations involving the SCC began in the early 1980s. William Nordhaus introduced the "shadow price of CO_2," and stressed that current policy should focus on the current CO_2 shadow price (Nordhaus 1982, p. 243). Today, the common term for Nordhaus's idea is the SCC. Based on the premise that CO_2 emissions today will remain in the atmosphere for millennia, the SCC is the monetary equivalent of the long-term climate impact of CO_2 emissions. One way to calculate the SCC is by taking the net present value of the difference between climate change damages along with a baseline climate change pathway and a marginal increase value of the same pathway attributed to the release of additional carbon dioxide. As marginal cost is defined as the cost of producing an additional unit of a particular good, this calculation determines the marginal climate impact of producing an additional unit of carbon and converts it to a monetary unit. The SCC is typically expressed in U.S. dollars and in tons of carbon. Put numerically, one ton of CO_2 contains 0.2727 tons of carbon, therefore, a $1 SCC amounts to $3.66 per ton of carbon. An increase in the SCC value leads to higher regulation and a reduction to the risks associated with climate change. Drilling down into the impact of the SCC metric, by including the SCC in the cost of production the total output of fossil fuels is reduced. The difficulty is in determining the correct SCC value.

There are several integrated assessment models (IAMs) used to estimate the SCC. A complete discussion of each model is beyond the scope of this essay; suffice it to say, the aim of these models is to integrate climate science and the economic impact of greenhouse gas (GHG) emissions. The trouble with IAMs is the subjective nature of economic inputs such as the discount rate and assumptions surrounding GHG emissions. By varying the discount rate, for instance, it is possible to generate wild swings in the SCC figure. Another key variable for SCC pricing involves geographical scope. Unlike the Obama administration, which used a global scope, the Trump administration focused on national numbers and reduced the SCC from Obama's $50 per ton levels to between $1 and $6 per ton of carbon (Wagner et. al. 2021). If IAMs continue to be used as tools for determining climate policy, the international community should establish a policy requiring a global scope for all IAMs to account for the global distribution of CO_2 emissions.

While IAMs have become more complex since the Dynamic Integrated Climate and Economy (DICE) model (Nordhaus 1991, 1993), they have not come any closer to realizing their goal (Pindyck 2013). The IPCC Report shows that IAMs cover "supply-side mitigation options…while many demand-side options are treated as part of underlying assumptions" (IPCC 2018, p. 111). The negative impact of this process is discussed in the demand-side versus supply-side policy debate below. Due to their inability to determine a universal number for the SCC, and their tendency to generate an illusory and misleading perception of knowledge (Pindyck 2013), IAMs should be used with caution when determining climate policy. I support an approach similar to assessing the threat of nuclear fallout after a U.S. – Soviet thermonuclear exchange that "helped evaluate the potential benefits of arms control agreements" (Pindyck 2013, p. 870). Since IAMs are incapable of determining objective outputs due to subjective input values, a better course of action is to establish reasonable estimates regarding the possible impact of climate change and establish policies that reflect the worst-case scenario.

A second policy recommendation relating to SCC and carbon taxes in general is the tax on carbon emissions absent any burden on fossil fuel producers. Current scenarios place the tax liability of the SCC on emitters, and oil producing nations are free from SCC payments placed on the global consumption of exported fossil fuels. This imbalance in carbon taxes is inequitable and inefficient.

I propose a more balanced carbon tax that includes producers in the equation. This begins with developing a national carbon index which is determined by the national average of carbon emissions per capita. The most successful effort for determining a carbon index is Hertwich and Peters (2009), but more work determining a global carbon index for nations is necessary, and is part of my ongoing research. The carbon index multiplied by the volume of fossil fuels exported from producing nations divided between nations generates a shared SCC and places the tax burden on both import and export nations. This basic equation is:

$$\text{Shared Cost} = (CI * t_{oe} / 2) * SCC$$

where CI is the carbon index, t_{oe} is tons of oil equivalent for any form of fossil fuel, and SCC is the social cost of carbon. Producing nations could offset their SCC by subtracting renewable energy export values from their portion SCC yielding:

$$\text{Shared Cost} = (CI * t_{oe} / 2 * SCC) – REt_{oe}$$

where REt_{oe} is renewable energy exports in tons of oil equivalent. Importing and carbon emitting nations could similarly reduce their portion of the shared tax through a reduction of imports and an increase in renewable energy production and distribution. From the equation it can be surmised that cooperating nations are incentivized to find ways to reduce the SCC through a combined effort to reduce fossil fuel consumption and increase renewable energy usage. To my knowledge, there is no current analysis using this equation. I argue, an international policy based on a shared SCC would lead to a reduction in oil exports from producing nations in favor of renewable energy exports and would increase the SCC values proportionally – leading to a global reduction in fossil fuel export and consumption.

In addition to worst-case scenario implementation and an adjustment to the SCC tax scheme, evidence supports the need to favor demand side policies over supply-side policies (IPCC 2018, p. 17). The key difference between these two policy instruments pertains to the prices on production (demand side) and consumption (supply side). These policies differ in their impact on carbon leakage, which is the unintended increase of oil production and consumption due to the application of economic policies. When modeling the produced quantity and the commodity price against the supply and demand curves, production market equilibrium is found at point, Q_{me}. If we then want to decrease global production to a desired market equilibrium, Q_{dme}, which is set as the amount of fossil fuel we can burn and remain at or below future climate targets, global demand or supply side policies are equal. That is to say, in a global market, when it is possible to enforce energy policy globally, supply and demand side policies yield the same result. Unfortunately, some countries are less inclined to follow global energy policies than others. When international climate agreements fail, demand side policies are more effective than supply side policies at reducing carbon leakage.

Demand side policies result in a decreasing oil price which leads to an increase in consumption; supply side policies increase the oil price causing an increase in production. This is in agreement with the IPCC report (2018, pp. 41, 97). Modeling production levels using supply and demand curves yields the same original production output (Q_{me}) for both models. By applying demand side policies at the national level through increased investment in renewable energy, reducing the demand for oil and lowering the price, it is possible to reduce oil production: $Q_{me} – Q_{dme}$ = Realized Reduction (R_R). The problem is, as the price of oil decreases it becomes economically logical for developing nations to consume fossil fuels. Attempting to achieve the same reduction in oil production using supply side policies increases the price of oil lowering consumer consumption but incentivizing oil producing nations to increase production. Although both policies lead to carbon leakage, demand-side policies result in a higher-level R_R and lower levels of carbon leakage than supply-side policies (Harstad and Liski 2012). For this reason, when the supply curve is steeper than the demand curve, which cannot be empirically determined but is assumed to be the case, governments should favor demand side policies when only one of the two options can be implemented. The best course of action, however, is to implement both demand and supply side policies simultaneously.

The assessment of national supply and demand side policies that could control the level of industrial activity and transition away from peak demand as the power supply decarbonizes (IPCC 2018, p. 140) can be shown through an example. Beginning in the 1990s Norway started implementing tax incentives on electric vehicles (EVs) (Mersky et al. 2021). This policy led to an increase in the number of EVs and a reduction in the demand for gasoline. Despite this reduction in demand, Norway increased oil production throughout 1990s due to an increased efficiency in drilling and production technologies, and while oil consumption in Norway averaged 200,000 barrels per day, its 3.4 million barrel per day output at peak production in

2001 made it the third largest exporter in the world (Höök 2008). As the supply grew, leading to a decrease in the oil price, international consumption levels of Norwegian oil increased, resulting in carbon leakage. The peak of Norway's oil production in 2001 has led to a forced reduction in oil production and export. Although reduced Norwegian oil production has not been based on supply-side policy and is instead a result of the declining supply in Norwegian oil fields, reduction models show Norway will "barely be an oil exporter by 2030 (Höök 2008, p. 4271). As its demand side policies in favor of EVs and renewable energy increase and declining oil production due to the depletion of its reservoirs lead to supply side restrictions, Norway will continue to reduce its contribution to carbon leakage. This is yet another reason to implement demand-side policies first. When the supply runs out, Norway will be ready.

We now turn our attention to an equally destructive oversight in our current climate policy. There is an increasing divide between nations that possess information relating to energy production and consumption, the real impact of carbon emissions on the climate and the resulting impact on the environment. This section will discuss the importance of information with regard to decision making. I will also show that the growing divide among information technologies reinforces control over developing nations, and that this exogenous control is detrimental to IPCC climate targets. Following that, I will provide several policy recommendations that could reverse this trend in information and, through the equal dissemination of information, assist the global community in its efforts to reach the IPCC climate targets.

Claude Shannon (1948) declared that one bit of information cuts uncertainty by half. The process is elegant. Listing the letters of the alphabet, Shannon showed that he could transmit information regarding a single letter to another individual in five bits of information. Answering yes or no to the binary question, “is the letter in the top section?” divides the alphabet and reduces uncertainty by half. Repeating the question halves uncertainty again and after five successive binary questions regarding the location of the letter in either the top or bottom of the remaining set of letters, information transmission for the specific letter is completed.

Martin Hilbert (2013) combined the Price equation (George Price 1970, 1972) and Shannon’s entropy and mutual information with information metrics, (Fisher 1930, 1958[1]; Kolmogorov 1941; Kullback-Leibler,1951; Massey 1990, 2005) to quantify growth in relation to information density and shows that optimal economic growth is derived through informed intervention and blind natural selection. What this means is, natural selection and evolution are not the same thing and that an organism evolving into an environment suitable for the next mutation is essential for positive growth. Information that provides insight into the future environment gives those with information an advantage. If an individual divides its resources among several possibilities, the distribution will be an even split – R/P, where R is total resources divided by P, the number of possibilities. Given one bit of information the set of possibilities is reduced by half, but the number of resources remains unchanged – doubling the number of resources devoted to each of the remaining possibilities. Allowing resources to be devoted to half of the original set gives the individual twice the opportunity to make the correct decision regarding the allocation of resources. The simplified equation for this is:

1 bit = 0.5(uncertainty) = 2(growth)

[1] Hilbert uses the 1930 first edition of *The Genetical Theory of Natural Selection*. I use the 1958 second edition.

In other words, one bit of information cuts uncertainty by half and doubles potential economic growth. Therefore, the more bits of information an individual has, the greater its chances for growth until R = P, where 100% of available resources are devoted to a final remaining possibility.

We are currently in a second stage of the digital divide; the universalization of digital devices ended stage one, but there is a growing divide in terms of information capacity (Hilbert, 2014). In 2001, the divide in digital devices, the real number of technological devices capable of transmitting information, between OECD countries and developing nations was 1.2/0.2 = 6; in 2006 the divide was 1.5/0.5 = 3, which shows the divide among digital devices was shrinking. However, in terms of information capacity, in 2001 the divide in kilobits (kbps) per person was 50/5 = 10, and in 2006 the divide was 700/50 = 14 (Hilbert 2014). This means that while the divide with regard to devices is shrinking, the divide in information capacity is growing. From Hilbert (2013), we can see that, in terms of growth based on information, the possibilities for economic growth in developing nations in relation to OECD countries are shrinking.

It is important to understand this issue from an economic perspective. Looking at the data revolution through an economic lens we can say that aggregate output is equal to the sum of capital and labor. To this equation we can now add digital capital and digital skills plus some residual data output, which is not quantified in traditional economic models. The difficulty is in the question of how to apply residual data outputs into economic growth models. The danger of including digital capital without including digital data is explained though Hilbert’s example of the shrinking digital capital divide and the increasing divide in residual digital data. As we have already discussed in the section on demand and supply economic policies, global climate policies are historically ineffective; each nation prefers to apply its own policy based on its own economic and political self-interests. Therefore, a policy among OECD nations that seeks to shrink the digital divide is essential for establishing effective climate policies at the national level in non-OECD countries. Put simply, although independent nations prefer to generate policies based on their own self-interest, local policies made using the shared global data regarding climate change will lead to a more standardized overall aggregate climate policy.

James Beniger (1986) published *The Control Revolution and* coined the term, which is defined as the "complex and interrelated sequences of rapid change in the technological and economic arrangements by which information is collected, stored, processed and communicated" (Beniger 1992, p. 12). His research focused on long standing policies regarding the assimilation of information as a method of control. There is a gap in academic research combining early ideas pertaining to communication in bits of information, the relationship between information and economic growth and the increasing divide among OECD countries and developing nations in access to information and informational capacity. Research into this field is necessary for the development of OECD climate policies if we are going to bring developing nations into the mix.

Another example from recent headlines will provide an example of how even a local digital divide in western nations can have catastrophic consequences. One of the most obvious, and still hotly debated, impacts of climate change concerns weather patterns. As events in the USA state of Texas show, even countries with the most abundant and up to date information can fall short when preparing for disruptions in weather patterns. These deficiencies led to disruptions to the state's power and water supply and had a devastating impact on its agricultural sector (Reiley 2021). Access to reliable information that has been filtered through the layers of control have kept Texans and other rural communities grounded to political policies that have limited their understanding of the impact of climate change. What is worse, rural communities across the United States are doubling down on these policies as can be witnessed in the recent CPAC conference in Orland, Florida (2021). This again speaks to the need for policy which promotes and insists upon the mass dissemination of accurate, unfiltered information.

Limited access to climate information has had lasting effects on developing nations throughout all sectors of their economies, and there has been an increasing call from researchers and informed policymakers to investigate the potential causes of environmental migration, future risks posed by climate change, and the role of migration within broader processes of adaptation. Researchers (Piguet 2010; Bates 2002; Gemenne 2011; Warner 2010) suggest a larger focus on empirical research in a field that has often been normative in scope. In order to develop empirical research into the effects of climate change, global policies must insist on an equitable and global dissemination of information.

This essay was a response to the IPCC 2018 Special Report on climate change. It provided economic and political policy recommendations that could help speed up the transition to sustainable development. Beginning with carbon taxes, I introduced an economic formula that would place the burden of the social cost of carbon (SCC) on countries that import and export fossil fuels. Current policies for the SCC limit the tax burden to emissions and these policies have no negative impact on exporting nations. Through the application of a new economic model, the SCC shared tax rate would reduce fossil fuel production in exporting countries and using the offset equation would incentivize a transition to renewable energy production and export. In addition to carbon tax policy, I provided evidence in support of a demand side economic policy for the reduction of fossil fuel production. Beginning with demand side policies and following through with supply side policies more effectively reduces carbon leakage. Finally, I included an area of research that demands further investigation. The second wave digital divide continues to disproportionately effect non-OECD nations and an open and equal dispersion of information will increase a developing nation's ability to make informed decisions regarding local, national climate policy. This will lead to faster and more effective aggregate global climate policy.

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