Analyzing the Regional Effects of Peter Barnes' "Sky Trust" Proposal

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Introduction

Climate change has become one of the most globally unifying challenges of the 21st century. Science has confirmed that humans are contributing to higher concentrations of CO_2 in our atmosphere which is directly correlated with rising global temperatures and the consequences which follow. Around the world, scientists, concerned citizens and some policy makers have called for serious reductions in carbon emissions which could help avoid the worst effects of drastic climate change. Recently there has been significant attention given to the goal of reducing global emissions 80% below the current level by the year 2050. To this end many proposals have been put forth. Some suggest a punitive tax on fossil fuels similar to federal taxes on alcohol and tobacco. Others have called for a cap and trade system similar to the system used to reduce sulfur dioxide emissions in the 1990s. However, time and again it has been found that these are regressive policies which would further the great inequalities between the rich and poor in this country. The only plan that has been found to have a truly progressive effect is the Sky Trust proposal, originally put forth by Peter Barnes in his book "Who Owns the Sky?" In this paper we seek to explain the merits of the Sky Trust proposal and explore the regional effects of a model that has proven benefits on the national level.

Background

In a paper published November 2007, James Boyce and Matthew Riddle of UMass-Amherst provide an excellent study of the progressive effects of the Sky Trust model[1]. They explain that a cap and dividend system is the best way to meet the necessary carbon reductions and protect the incomes of lower and middle income families.

Barnes' proposed Sky Trust has five key components:

1. A cap is set on the amount of CO_2 that can be emitted every year.
2. Suppliers of fossil fuels must buy a permit for every ton of CO_2 they wish to bring to the marketplace.
3. The permits are sold at public auctions on an annual or quarterly basis.

[1] Boyce, James K. & Riddle, Matthew. "Cap and Dividend: How to Curb Global Warming While Proteching the Incomes of American Families." University of Massachusetts Amherst, 2007.

4. Every year the number of permits sold is reduced, in order to reduce emissions and meet predetermined goals.
5. All the revenue generated through the sale of carbon permits is redistributed to Americans as a dividend, one share per citizen.

The simplicity and progressive nature of this proposal are as innovative as they are effective. Rather than attempt to set a price on carbon and hope that this reduces consumption by a certain margin, designating the number of permits and allowing the markets to determine the price of carbon is much more efficient and guarantees that emission reductions are met. Also, capping the production of fossil fuel rather than the sale of final goods and services makes it easier to administer permit sales and allows producers to decide how much of the permit price to pass through to consumers. Finally, higher fossil fuel prices provide market incentives for consumers to shift away from carbon intensive goods, and knowing that their dividend is predetermined, the less they spend on carbon charges throughout the year the greater their net benefit will be once the dividend is factored in.

What sets the Sky Trust model apart is that rather than use the revenue generated by carbon charges to fund public spending, the pool of funds would be paid out as a dividend to every citizen of the U.S., similar to Alaska's permanent fund. This provides a great incentive for people to reduce their consumption of carbon intensive goods, and protects the income of those who can least afford an additional cost of living. For people of lower income, annual expenditures on fossil fuels represent a greater proportion of their total expenditures, and therefore a carbon charge is seemingly unjust. However, due to higher total carbon charges by those who with greater expenditures, the dividend returned to all citizens is proportionally greater for those in the lower expenditure deciles. For a quantitative analysis of the benefits of auctioning permits versus giving these permits to historic producers, see the aforementioned piece by Boyce and Riddle.

On a national level the Sky Trust has been shown to be the most progressive and equitable proposal that includes the right incentives and constraints to meet our carbon reduction goals. However as for any proposal, it is important to also analyze regional variations which are glossed over through aggregate analyses. It is easy to imagine that different regions of the country depend more on fossil fuels than others, and this variations could potentially lead to some areas being left at a disadvantage. Without research that resolves these issues it would be hard to sell the Sky Trust model to politicians that must keep their constituents economic well-being as a top priority. It is the goal of this study to check whether regional variation could be too great so as to undermine the overall benefit created by the Sky Trust proposal.

Methods

Our analysis is founded on expenditure data generously provided by Matthew Riddle, of UMass-Amherst. Riddle used Stata code to extract annual per capita expenditure data for consumers in the four different regions of the country as defined by the Bureau of Labor Statistics[2]. The table for the North East region is given below as an example.

North East

2003 household expenditures by income decile (in 2003 dollars)									
Per capita expenditure decile	Per capita expenditure ($)	average per capita expeditures by expenditure category							
		Food	Industrial Goods	Services/ Other	Electricity	Household Fuels	Car Fuels	Air Transport	Other Transport
1	1927	659	225	729	128	52	124	3	8
2	3521	1118	426	1418	227	83	226	11	13
3	4736	1361	638	2001	278	113	304	23	18
4	5991	1621	904	2559	341	144	375	28	19
5	7380	1813	1188	3351	349	164	444	45	27
6	8847	2051	1795	3849	380	186	489	67	30
7	10711	2297	2219	4901	415	211	537	83	46
8	13228	2559	3343	5880	459	214	614	105	54
9	17178	3081	4821	7489	519	273	735	177	83
10	29943	4292	10908	12363	642	334	888	367	149
Total	10346	2085	2647	4454	374	177	474	91	45

Calculating Regional Loading Factors

The first step in our analysis was to calculate loading factors which we could use to determine carbon charges for every type of expenditure in each region. Loading factors are a measure of carbon intensity. Their units are tons of carbon per $1000 expenditure. This form allows for easy comparison of carbon content between sectors. We borrowed

[2] Regions: North East: ME, NH, MA, VT, CT, RI, NY, NJ, PA
South: AL, AR, DE, FL, GA, KY, LA, MD, MS, NC, SC, TN, TX, VA, WV, DC, OK
Mid West: IL, IN, IA, KS, MI, MN, MO, NE, ND, SD, OH, WI
West: AK, AR, CA, CO, HI, MT, ID, NV, NM, OR, WA, UT, WY

loading factors from a study by Metcalf for most expenditure sectors[3]. However, we recalculated our own regional loading factors for electricity, household fuels, and car fuels. Our logic here was that regional differences in the price of food and clothing will be trumped by regional differences in energy prices. Moreover, calculating the small differences in regional loading factors for food and clothing is very complex and well beyond the scope of this study. Energy prices, on the other hand, will affect regional expenditures significantly and the prices and consumption information associated with these sectors is well documented. The calculations are described below. Our regional loading factors can be found in Appendix B.

Electricity

CO_2 is emitted when electricity is generated from sources such as coal and natural gas. The amount of CO_2 produced by electricity in each region depends on the composition of the electricity portfolio and the efficiency of the power plants. Since in many cases, citizens cannot choose where their electricity comes from, inequity due to variations in regional electricity sources is a valid point of concern which warrants quantification.

To calculate the regional loading factors for electricity, we used three sets of state data. First, we use the state annual CO_2 emissions output rate[4]. These statistics, with units of carbon per Megawatt-hour, take into account both the efficiency and type of electricity plants in each state. Second, we must take into account the price of residential electricity. The reason why we consider the price is that if the electricity is expensive in one state, the percentage increase in price will be lower than in a state with cheap electricity. The first two statistics can be used to calculate the loading factor for each state. To find regional loading factors, we must weigh the loading factor of each state by the residential expenditure of that state. The calculation below was performed for each state in the region. We summed the products for each state and divided by the total expenditure of all states in the region, giving us an expenditure-weighted average of the loading factors.

[3] Metcalf, Gilbert E. "A Distributional Analysis of Green Tax Reforms" National Tax Journal, 1999.
[4] EPA www.epa.gov

$$\frac{\left(\frac{tons\ of\ Carbon}{MWh}\right)}{\left(\frac{\$}{MWh}\right)} \times State\ Electricity\ Expenditure = State\ Loading\ Factor$$

Household Fuels

Household fuels include natural gas and distillate fuels. They are used for heat and hot water. The carbon content of a gallon of distillate fuel or 1000 ft^3 of natural gas does not change regionally. However, the two fuels have different loading factors and regions tend to favor one fuel type. In addition, prices vary regionally and thus affect loading factors. In general, distillates produce more carbon per dollar than natural gas. So regions that favor distillate, such as the northeast, will incur a greater cost.

To find regional loading factors, we calculate the loading factors for distillate and natural gas for each state. This is achieved by dividing the carbon emissions output per unit of fuel by the price per unit fuel. We used data from the Energy Information Administration[5]. Next, we weighed these loading factors by the average state expenditure of that particular fuel. In the expression below, which calculates the northeastern loading factor, DLF and GLF stand for distillate loading factor and gas loading factor, respectively. SDE and SGE stand for state distillate expenditure and state gas expenditure.

$$\frac{(VT\ DLF \times VT\ SDE) + (VT\ GLF \times VT\ SGE) + (ME\ DLF \times VT\ SDE) + (ME\ GLF \times VT\ SGE) + \ldots}{Total\ Northeastern\ Expenditure\ on\ Gas\ and\ Distillate}$$

As before, we sum each weighted loading factor for every state in the region and divide by the total expenditure to produce a weighted average.

Car Fuels

When calculating the loading factor for car fuels, we simplified our calculations by assuming that most citizens use gasoline as their primary car fuel. Thus, the only statistic we needed to take into account, other than the carbon content of gasoline, was

[5] Energy Information Administration. www.EIA.gov

the regional price. Using data from the EIA, we calculate the loading factor by dividing the carbon content per gallon of gasoline by the price[6].

$$\frac{\left(\frac{tC}{gallon\ gas}\right)}{\left(\frac{regional\ price\ (\$)}{gallon\ gas}\right)} = \mathrm{Re}\,gional\ Loading\ Factor$$

Adjusting Expenditures

The next step was to predict expenditure behavior. All prices will increase, however, some sectors increase much more than others. Thus, consumers will tend spend more in sectors that are relatively cheaper. To deal with this, we calculate real price increases relative to the average price increase, the rate of inflation. Elasticities are applied to real, rather than nominal, price increases in order to calculate changes in demand. The elasticity for each sector, sourced from Boyce and Riddle, predicts the change in quantity due to a price increase.

Once we had these factors for each of the four regions we were able to manipulate the expenditure tables provided by Riddle to determine the carbon charge incurred by each decile of consumers in each region of the country. Our first adjustment increased the nominal prices and the decreased the consumption to achieve raw adjusted expenditure data. This adjustment reflects the how consumers would spend without getting a rebate. With the rebate, consumers will naturally spend more. Thus, we increased the sector expenditures of each decile proportionally until the total expenditure equaled the original expenditure plus the rebate. Using these numbers, we removed the nominal price increases to determine the carbon charge using 2003 prices. The sum of carbon charges for each expenditure decile was then subtracted from the dividend to determine the net effect for each decile in each region.

[6] Energy Information Administration. www.eia.gov

Below is the net benefit table for the North East region with $200/tC.

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	House-hold Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	2155	3.3	-132	477	345	-6.12%	22.12%	16.00%
2	3850	3.4	-204	477	272	-5.31%	12.38%	7.07%
3	5083	2.9	-265	477	211	-5.22%	9.38%	4.16%
4	6604	2.9	-331	477	146	-5.01%	7.22%	2.21%
5	7940	2.7	-371	477	106	-4.67%	6.00%	1.33%
6	9365	2.4	-424	477	52	-4.53%	5.09%	0.56%
7	11133	2.3	-492	477	-15	-4.42%	4.28%	-0.14%
8	13516	2.2	-555	477	-78	-4.11%	3.53%	-0.58%
9	17588	2.0	-709	477	-232	-4.03%	2.71%	-1.32%
10	32395	1.8	-1124	477	-647	-3.47%	1.47%	-2.00%

In order to calculate the national dividend we took the average carbon charge from all ten deciles on the national level. This dividend was then applied to all four regions, as is the plan under the Sky Trust. Our calculated dividend is significantly less than that used by Boyce and Riddle due to our use of updated carbon intensity data. In our data, fuel prices were higher than those used by Boyce and Riddle, therefore there is less carbon in $1000 worth of fuel. This reduces the carbon charge which in turn reduces the dividend. Lower dividends do not affect which deciles are net beneficiaries, it only affects the amplitude of the gains or losses; the greater the dividend, the larger the net benefit or loss to the poorest and richest deciles respectively.

The Price of Carbon

Peter Barnes suggests setting a price ceiling at $25/tC for the first four years in order to assure that the shock value of elevated energy prices does not cause the US to lose the willpower necessary to break our addition to a carbon based economy. However, after four years of a price ceiling at $25/tC, the price of carbon would be determined by an auction between fossil fuel suppliers. In order to reduce carbon emissions 80% by year 2050 the long term price of carbon will have to rise significantly. A recent report by the MIT Joint Program on the Science and Policy of Global Change suggests that an initial price of $180/tC will have to rise to $730 over the next forty years to achieve this goal (Paltsev et al., 2007).

Boyce and Riddle base their calculations on a carbon price of $200 a ton.

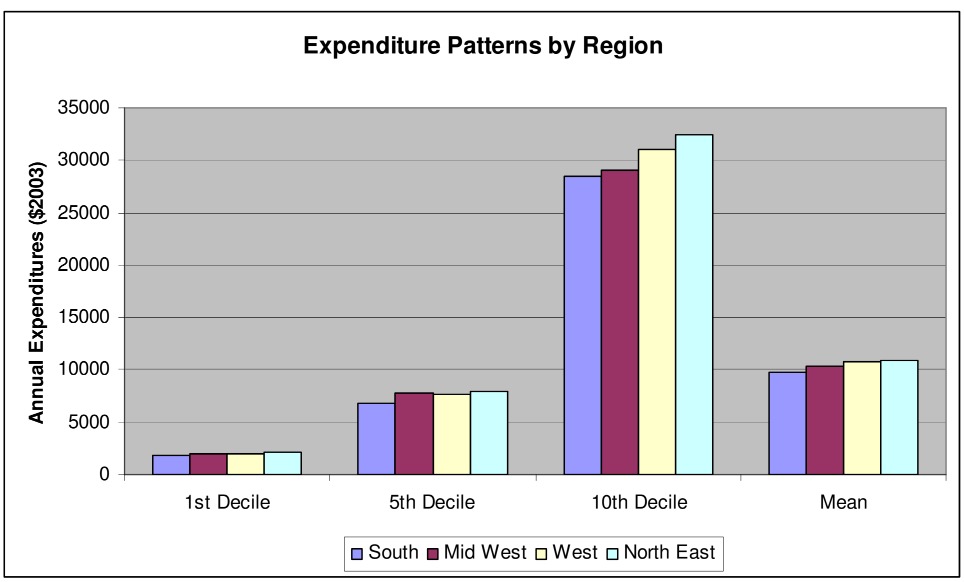
> "We estimate that a $200 per ton carbon charge would reduce U.S. emissions by approximately 7%. Put differently, if a cap on annual carbon emissions is set at 7% below current levels, and the corresponding number of carbon permits is auctioned to fossil fuel suppliers, we estimate that the market price for these permits will be approximately $200/tC."

By this logic, we would expect to hit a price of $200/tC between three and four years after initiating the Sky Trust proposal. Four years is relatively short term as we look at emission reductions throughout the 21st century, but four years is also a political cycle, which means everything to the powers that be in Washington.

Regional:

The Sky Trust is designed to curb carbon emissions while having a neutral or even progressive effect on the incomes of American families. The national numbers show that this can be achieved. However, if these benefits are confined to only certain areas of the countries, while other regions lose their economic advantage, then the proposal will lose much of its credibility.

Even before enacting a carbon price, consumers in different regions of the country behave differently. Overall, the North East region spends the most on expenditures by a healthy margin. On average consumers in the North East spent 12% more than those in the South and 5% more than those in the Mid West. The chart below highlights the variation in regional expenditure patterns in 2003.



Our research has found that while there is some regional variation, across the country there is no region that will be left at a serious disadvantage that would undermine the merit of the Sky Trust.

$25/tC

Due to Barnes' recommendation that a short term price ceiling be set at $25/tC this was the first price we chose to analyze. At $25/tC, the amount of revenue generated by permit sales is significantly lower than that produced by $200 carbon. To put the scale these carbon charges in perspective, the average carbon charge nation-wide, and therefore the dividend paid out to each individual would be approximately $61.23. On a national level the carbon charges would range between $16 and $145 for the 1st and 10th deciles respectively. This represents less than 1% of the annual expenditure of each decile, and on the microeconomic scale is essentially insignificant. However, for the first decile, the dividend represents over 3% of their annual expenditures, and these consumers come away with a net benefit of 2.4%. Even though these numbers are small, $25 carbon would be an excellent starting point, and would show Americans that we can mitigate climate change without putting a damper on our national economy.

On a regional level, due to the scale of the charges there is little variation at all. The 1st decile in each region receives a net gain between 2.15% (Northeast) and 2.44% (South) of their current consumption. Again, to put this in perspective, some of the consumers in the 1st decile will end up with $42 net gain while others will have up to a $49 net gain. The richest decile will experience a net loss that represents between .25% (West) and .32% (Midwest) of their current annual expenditures. For all regions except the Mid West, the first three quintiles will experience a net gain, while in the Mid West the 6th decile will experience a net loss of $7. Below is a chart which illustrates the percent gain/loss for each decile in each region.

Expenditure Decile	National	North East	Mid West	South	West
1	2.37%	2.15%	2.19%	2.44%	2.43%
2	0.97%	0.95%	0.74%	0.95%	1.11%
3	0.55%	0.56%	0.32%	0.48%	0.68%
4	0.29%	0.30%	0.12%	0.31%	0.41%
5	0.15%	0.18%	0.00%	0.10%	0.25%
6	0.04%	0.08%	-0.07%	0.01%	0.14%
7	-0.04%	-0.02%	-0.14%	-0.09%	0.03%
8	-0.12%	-0.07%	-0.22%	-0.16%	-0.05%
9	-0.20%	-0.17%	-0.26%	-0.25%	-0.13%
10	-0.28%	-0.26%	-0.32%	-0.31%	-0.25%

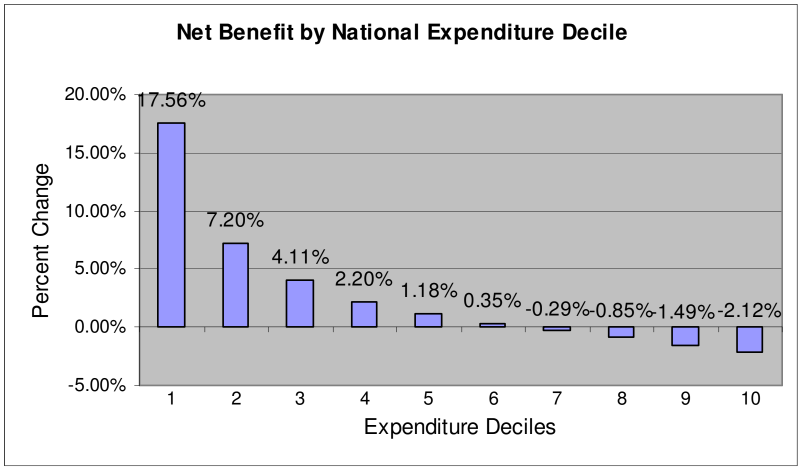
The scale of this variation is well within our expectations and it is our belief that there is no substantial inequality that might undermine the merit of the Sky Trust. As the price of carbon rises, the amplitude of carbon charges and net affects increases substantially. As mentioned above, Boyce and Riddle use $200 carbon in their paper, and we therefore chose this number to do a long term analysis of the regional effects of the Sky Trust.

$200/tC

Our second scenario is based on an estimated price of $200/tC. The price is not expected to be this high in the initial years of the cap-and-dividend policy. Nonetheless, this scenario gives us an idea of how the policy may play out in the long term.

On the national level, with a dividend of $477, the net benefit is positive for the lower six expenditure deciles. This means that 60% of consumer units across the country will be able to increase their per capita expenditures without cutting further into their disposable income. Furthermore, the 7th and 8th deciles have a net loss that represents less than 1% of their current per capita expenditures. Only the wealthiest two deciles are subject to a carbon charge that is significantly higher than the dividend, and these consumers end up losing between 1.5% and 2.1% of their annual per capita expenditures. However, their loss will diminish if they change their consumption patterns by more than the elasticities of demand for fossil fuels predict they will.

The net benefit by expenditure decile for the nation is below:



As illustrated in the graph above, the Sky Trust model is steeply progressive, and would vastly increase the disposable income of the nation's poorest citizens. The model meets Barnes' claim of preserving the income of middle and lower income Americans while curbing carbon emissions. This is where Boyce and Riddle left off, with nationally averaged net benefits. We picked up their research to look further into regional variation of the effects of the Sky Trust.

Since our calculated carbon intensities were lower than those used in Boyce's paper, the charges incurred by each decile were lower and the dividend was smaller. We used the nationally averaged expenditure data to calculate the new rebate. By adjusting the rebate until the sum of the net nominal benefits was zero, we found a per capita dividend of $477. The national distributional effects are shown in Appendix D. Though the regional analysis is the main thrust of our research, the national results are useful for comparison. Note that the lowest six expenditure deciles come out ahead financially.

Under the SkyTrust proposal, every citizen receives the same dividend. Thus we use the dividend above for the regional calculations. However, since the expenditure patterns and carbon intensities vary regionally, the average charges are different for each region. The tables in Appendix D show the regional distribution impacts of the SkyTrust. Note that in each region, the policy is still progressive.

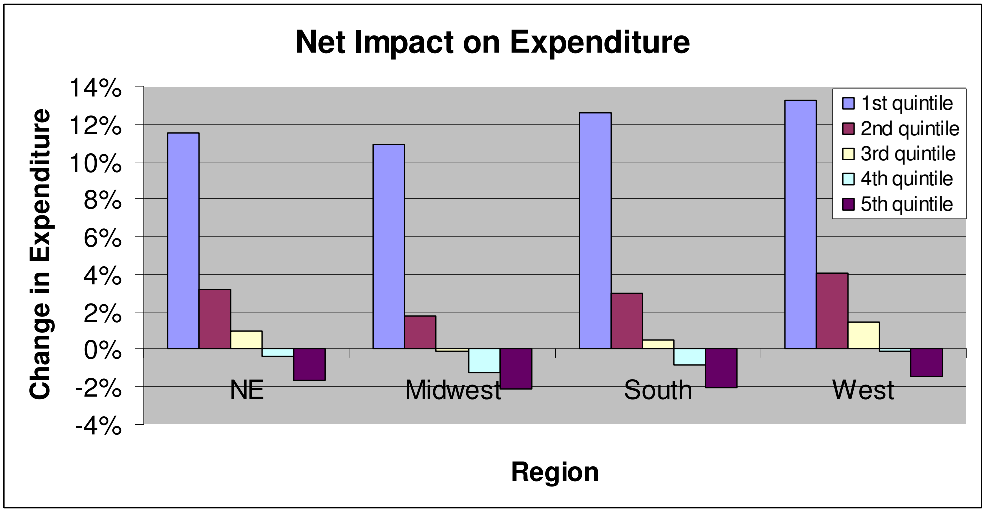
Compared to the other regions, the Midwest does the worst. On average, Midwesterners will incur a charge of $541. Thus, after receiving the $477 dividend, they will be set back $64. The main reason for the high charge is that electricity production in the Midwest emits much more carbon than in other regions. The price increases in household and car fuels is also high when compared to other regions. Despite the increased costs, however, the bottom half of the population comes out ahead.

The cap-and-dividend benefits the Northeast slightly more than the Midwest. As seen in Appendix D, the six lowest deciles come out ahead. The Northeast has the least carbon intensive electricity generation of all the regions. However, they spend the most on household heating fuels. Also, the Northeast uses distillate fuel for much of its household fuel needs, while the rest of the country uses natural gas almost exclusively. Distillate fuel produces more carbon per dollar than natural gas. Regardless, the Northeast residents will come out slightly ahead of the national average.

The Southern region comes out slightly behind the national average, largely due to a significant increase in the price of electricity. The main reason that the South does better than the Midwest is that they spend less per capita then the rest of the country. Due to the progressivity of the policy, less spending translates into a greater net benefit. The six lowest deciles benefit financially.

The West benefits more than any other region, as seen in Appendix D. In fact, 70% of consumers from the West come out ahead. Spending on electricity and household fuels is below average. Also, the price increase in electricity is far below average. Car fuel expenditures are high, though the prices will increase less than in other regions.

The variations in net outcome between regions are quantifiable but not drastic. The most notable result is that the middle expenditure quintile comes out behind in the Midwest. That is, just over half of the population, including some of the middle class, loses under the proposal. This may present an obstacle for Midwestern politicians that may otherwise choose to favor a cap on carbon. We will discuss possible solutions later in this paper.



Conclusion and Suggestions:

As we have shown, the distributional effects of the Sky Trust policy only vary slightly by region. For this reason, we believe that enough political support could be gained to pass the policy. It is entirely possible, though, that Midwestern politicians will not be fully pleased. If this is the case, we would like to offer one addendum to the proposal that may appease the Midwesterners. At the moment, the SkyTrust model distributes revenue evenly to each American, even though some regions pay more and may not have a less carbon intensive substitute for many of their expenditures. One way to resolve this is to allow the dividend to have different values in each region. Using a method similar ours, a federal agency such as the EIA could calculate the average charge that citizens in each region incur. The regional dividends would be equal or proportional to the average regional charge. For example, instead of every American receiving a $477 dividend, Midwesterners would receive about $540 and New Englanders would receive about $460. This way, the policy would have the same distributional effects in each region. That is, about sixty percent of the population in any given region would benefit financially. Furthermore, carbon charges in each region will likely converge over time due to price signals. Since there will be a greater price signal in the Midwest to find substitutes for carbon intensive goods, their carbon emissions should drop quicker. At some point the regional dividends may become unnecessary and equal national dividends would be reinstated.

Even ignoring the caveat regarding a regional dividend structure, we strongly believe that the Sky Trust is the best policy proposal put forth to date. As Boyce and Riddle explained in their paper, there is no other proposal that can guarantee carbon reductions without hurting the economic welfare of American families. This leads to some interesting conclusions and further questions, such as: what would be the impacts on GDP growth due to a progressive redistribution of wealth? Right now Congress is discussing plans to give families tax rebates of $300 to $600 per capita to stimulate the economy and hopefully stave off a recession. The Sky Trust would have a similar effect every year when dividends are mailed out to citizens. Also, rather than give money to upper class families that will probably not spend the money and create the desired multiplier effect, the Sky Trust favors lower and middle class families that are more likely to spend a large portion of that dividend and bolster the economy. How would the international community react to the successful implementation of a US Sky Trust? Many have spoke of how the first country to act on climate change will take the biggest hit economically. However, with proper use of carbon tariffs on imports, these policies could strengthen our economy and the US may once again be able to set an example for the world to follow. There are many such opportunities that would arise with the successful implementation of the Sky Trust, and these are simply byproducts of a much needed plan to cut carbon in the 21st century. It is our strong belief that the relatively small regional differences can and should be ignored by politicians in order to expedite the process of carbon reductions. Also, there is a good chance that the cost of administering a regional dividend would outweigh the benefits of a proportionally equal dividend, and cut into the net benefit received by all consumers.

Acknowledgements: Many thanks to Peter Barnes, Jim Boyce, Jon Isham, and Matt Riddle for their insight and guidance throughout this process.

Appendix A.

Expenditure Data by Region
Provided by Matt Riddle, UMass-Amherst

North East

2003 household expenditures by income decile (in 2003 dollars)									
Per capita expenditure decile	Per capita expenditure ($)	average per capita expeditures by expenditure category							
		Food	Industrial Goods	Services/ Other	Electricity	Household Fuels	Car Fuels	Air Transport	Other Transport
1	2155	757	241	807	122	93	108	4	23
2	3850	1289	443	1534	207	139	174	19	45
3	5083	1532	709	2059	271	189	253	22	47
4	6604	1808	941	2862	342	229	345	31	45
5	7940	1992	1296	3540	334	243	409	63	63
6	9365	2151	1821	4171	327	316	420	100	59
7	11133	2467	2186	5076	387	376	467	70	104
8	13516	2639	3207	6079	401	329	591	141	129
9	17588	3335	4658	7680	467	467	672	192	116
10	32395	4820	9784	15101	657	591	784	387	271
Total	10963	2279	2529	4891	351	297	422	103	90

South

2003 household expenditures by income decile (in 2003 dollars)									
Per capita expenditure decile	Per capita expenditure ($)	average per capita expeditures by expenditure category							
		Food	Industrial Goods	Services/ Other	Electricity	Household Fuels	Car Fuels	Air Transport	Other Transport
1	1805	629	207	660	155	31	119	1	4
2	3292	1048	413	1277	268	52	225	3	5
3	4426	1270	513	1892	367	82	276	16	9
4	5523	1488	815	2388	356	87	360	19	11
5	6776	1740	957	3033	444	104	439	41	17
6	8106	1819	1638	3505	465	106	508	53	12
7	9953	2185	2012	4495	522	120	532	68	20
8	12758	2485	3201	5677	559	127	606	72	31
9	16537	2980	4733	7019	660	182	765	135	63
10	28504	3979	10988	11320	756	211	890	268	93
Total	9768	1962	2548	4127	455	110	472	68	27

Mid West

2003 household expenditures by income decile (in 2003 dollars)									
Per capita expenditure decile	Per capita expenditure ($)	average per capita expeditures by expenditure category							
		Food	Industrial Goods	Services/ Other	Electricity	Household Fuels	Car Fuels	Air Transport	Other Transport
1	1931	651	196	744	116	80	135	2	6
2	3644	1145	446	1431	214	134	253	12	8
3	4954	1433	719	1965	282	170	361	17	8
4	6270	1610	1008	2671	295	253	403	19	11
5	7751	1896	1275	3471	338	236	459	50	26
6	9282	2091	2050	3948	348	257	515	53	22
7	10954	2356	2280	4983	388	277	574	67	28
8	13203	2520	3277	5848	460	306	645	112	34
9	17127	2919	4988	7419	457	353	738	180	74
10	29013	3812	11517	11307	560	407	881	388	141
Total	10413	2043	2776	4379	346	247	496	90	36

South

2003 household expenditures by income decile (in 2003 dollars)									
Per capita	Per capita	average per capita expeditures by expenditure category							
expenditure decile	expenditure ($)	Food	Industrial Goods	Services/ Other	Electricity	Household Fuels	Car Fuels	Air Transport	Other Transport
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6	9282	2091	2050	3948	348	257	515	53	22
7	10954	2356	2280	4983	388	277	574	67	28
8	13203	2520	3277	5848	460	306	645	112	34
9	17127	2919	4988	7419	457	353	738	180	74
10	29013	3812	11517	11307	560	407	881	388	141
Total	10413	2043	2776	4379	346	247	496	90	36

Appendix B

	Loading Factors				
Category	**National**	**North East**	**South**	**Mid West**	**West**
Food	0.15	0.15	0.15	0.15	0.15
Industrial Goods	0.14	0.14	0.14	0.14	0.14
Services	0.08	0.08	0.08	0.08	0.08
Electricity	1.85	1.06	2.27	2.64	1.41
Household Fuels	1.65	1.63	1.47	1.76	1.75
Car Fuels	0.79	0.77	0.82	0.80	0.75
Air Transport	0.56	0.56	0.56	0.56	0.56
Other Transport	0.30	0.30	0.30	0.30	0.30

Appendix C

Carbon Charge and Net Benefit Data by Region: $25/tC

North East

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	Household Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	2155	3.3	-15	61	46	-0.69%	2.84%	2.15%
2	3850	3.4	-25	61	37	-0.64%	1.59%	0.95%
3	5083	2.9	-33	61	28	-0.65%	1.20%	0.56%
4	6604	2.9	-42	61	20	-0.63%	0.93%	0.30%
5	7940	2.7	-47	61	14	-0.59%	0.77%	0.18%
6	9365	2.4	-54	61	7	-0.58%	0.65%	0.08%
7	11133	2.3	-63	61	-2	-0.57%	0.55%	-0.02%
8	13516	2.2	-71	61	-10	-0.53%	0.45%	-0.07%
9	17588	2.0	-92	61	-30	-0.52%	0.35%	-0.17%
10	32395	1.8	-146	61	-84	-0.45%	0.19%	-0.26%

South

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	Household Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	1805	3.3	-17	61	44	-0.95%	3.39%	2.44%
2	3292	3.4	-30	61	31	-0.91%	1.86%	0.95%
3	4426	2.9	-40	61	21	-0.91%	1.38%	0.48%
4	5523	2.9	-44	61	17	-0.80%	1.11%	0.31%
5	6776	2.7	-54	61	7	-0.80%	0.90%	0.10%
6	8106	2.4	-61	61	0	-0.75%	0.76%	0.01%
7	9953	2.3	-70	61	-9	-0.70%	0.62%	-0.09%
8	12758	2.2	-81	61	-20	-0.64%	0.48%	-0.16%
9	16537	2.0	-103	61	-42	-0.62%	0.37%	-0.25%
10	28504	1.8	-148	61	-87	-0.52%	0.21%	-0.31%

Mid West

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	Household Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	1931	3.3	-19	61	42	-0.98%	3.17%	2.19%
2	3644	3.4	-34	61	27	-0.94%	1.68%	0.74%
3	4954	2.9	-46	61	16	-0.92%	1.24%	0.32%
4	6270	2.9	-54	61	7	-0.86%	0.98%	0.12%
5	7751	2.7	-61	61	0	-0.79%	0.79%	0.00%
6	9282	2.4	-68	61	-7	-0.73%	0.66%	-0.07%
7	10954	2.3	-77	61	-16	-0.70%	0.56%	-0.14%
8	13203	2.2	-91	61	-30	-0.69%	0.46%	-0.22%
9	17127	2.0	-106	61	-45	-0.62%	0.36%	-0.26%
10	29013	1.8	-155	61	-94	-0.54%	0.21%	-0.32%

West

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	Household Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	1995	3.8	-13	61	49	-0.64%	3.07%	2.43%
2	3577	3.6	-21	61	40	-0.60%	1.71%	1.11%
3	4791	3.4	-29	61	32	-0.60%	1.28%	0.68%
4	6162	2.8	-36	61	25	-0.58%	0.99%	0.41%
5	7629	2.8	-42	61	19	-0.55%	0.80%	0.25%
6	9117	2.6	-48	61	13	-0.53%	0.67%	0.14%
7	11143	2.5	-58	61	4	-0.52%	0.55%	0.03%
8	13724	2.1	-68	61	-7	-0.50%	0.45%	-0.05%
9	18026	2.1	-85	61	-24	-0.47%	0.34%	-0.13%
10	31015	1.7	-138	61	-77	-0.44%	0.20%	-0.25%

Appendix D

Carbon Charge and Net Benefit Data by Region: $200/tC

North East

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	Household Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	2155	3.3	-132	477	345	-6.12%	22.12%	16.00%
2	3850	3.4	-204	477	272	-5.31%	12.38%	7.07%
3	5083	2.9	-265	477	211	-5.22%	9.38%	4.16%
4	6604	2.9	-331	477	146	-5.01%	7.22%	2.21%
5	7940	2.7	-371	477	106	-4.67%	6.00%	1.33%
6	9365	2.4	-424	477	52	-4.53%	5.09%	0.56%
7	11133	2.3	-492	477	-15	-4.42%	4.28%	-0.14%
8	13516	2.2	-555	477	-78	-4.11%	3.53%	-0.58%
9	17588	2.0	-709	477	-232	-4.03%	2.71%	-1.32%
10	32395	1.8	-1124	477	-647	-3.47%	1.47%	-2.00%

Mid West

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	Household Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	1931	3.3	-163	477	314	-8.45%	24.69%	16.25%
2	3644	3.4	-271	477	205	-7.45%	13.08%	5.63%
3	4954	2.9	-352	477	125	-7.10%	9.62%	2.53%
4	6270	2.9	-412	477	65	-6.57%	7.60%	1.04%
5	7751	2.7	-464	477	12	-5.99%	6.15%	0.16%
6	9282	2.4	-516	477	-39	-5.56%	5.14%	-0.42%
7	10954	2.3	-580	477	-104	-5.30%	4.35%	-0.95%
8	13203	2.2	-681	477	-205	-5.16%	3.61%	-1.55%
9	17127	2.0	-799	477	-322	-4.66%	2.78%	-1.88%
10	29013	1.8	-1171	477	-694	-4.04%	1.64%	-2.39%

South

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	Household Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	1805	3.3	-151	477	326	-8.35%	26.40%	18.05%
2	3292	3.4	-242	477	234	-7.36%	14.48%	7.12%
3	4426	2.9	-316	477	161	-7.13%	10.77%	3.64%
4	5523	2.9	-345	477	131	-6.25%	8.63%	2.38%
5	6776	2.7	-419	477	57	-6.19%	7.04%	0.84%
6	8106	2.4	-466	477	10	-5.75%	5.88%	0.13%
7	9953	2.3	-533	477	-56	-5.35%	4.79%	-0.56%
8	12758	2.2	-620	477	-143	-4.86%	3.74%	-1.12%
9	16537	2.0	-782	477	-305	-4.73%	2.88%	-1.84%
10	28504	1.8	-1126	477	-650	-3.95%	1.67%	-2.28%

West

Distributional Incidence of a US sky trust								
Per capita expenditure decile	Per capita expenditure ($)	Household Size	Per capita incidence			% of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	1995	3.8	-115	477	362	-5.74%	23.90%	18.16%
2	3577	3.6	-179	477	297	-5.01%	13.33%	8.32%
3	4791	3.4	-235	477	242	-4.90%	9.95%	5.05%
4	6162	2.8	-288	477	189	-4.68%	7.74%	3.06%
5	7629	2.8	-335	477	142	-4.39%	6.25%	1.86%
6	9117	2.6	-381	477	96	-4.18%	5.23%	1.05%
7	11143	2.5	-453	477	24	-4.06%	4.28%	0.22%
8	13724	2.1	-534	477	-57	-3.89%	3.47%	-0.42%
9	18026	2.1	-661	477	-184	-3.67%	2.64%	-1.02%
10	31015	1.7	-1067	477	-590	-3.44%	1.54%	-1.90%