Optimum Revenue Allocation to Consumers

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****DRAFT FOR COMMENTS ** 11th August 2009**

Summary:
We calculate the fraction of carbon auction revenue that must be re-distributed to households in the form of equal per capita dividends in order to ensure that the average household in each of the bottom three per capita income deciles is not made worse off by the carbon policy. The break-even dividend is calculated by equating the average household dividend with the average increase in fuel prices (electricity, natural gas, and gasoline). We find that it is only necessary to return a third of auction revenues in order to achieve this goal, and this result is largely independent of the carbon price. In order to ensure that the average household in each of the bottom five deciles is not made worse off by the policy, 39% of revenues must be returned as per capita dividends.

Methodology:
The American Community Survey provides data on household incomes and electricity expenditures for nearly 400,000 households in CA, which we sort into deciles of per capita income. The households are sorted into 41 regions, and we match each region with the electric and natural gas utility(s) serving that region. In this way, we can calculate the increase in expenditure due to higher electricity and natural gas prices in 2020[1]. The electricity sector is assumed to de-carbonize by 10% relative to 2007, in line with CA's goal of reducing emissions to 1990 levels by 2020. Electricity and natural gas prices in 2020 are determined by an assumed annual real rate of price escalation (independent of the carbon price) and by the carbon price. Natural gas consumption in 2020 is calculated by assuming a price elasticity of demand of -0.2.[2]

Household transportation expenditures are estimated using Bureau of Labor Statistics Consumer Expenditure Survey data to calculate per capita gasoline consumption by decile in California. These expenditures are then weighted by region based on California Energy Commission data on total gasoline consumption by region in 2006. We assume a price elasticity of demand for gasoline of -0.3.[3]

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[1] A few of the regions are missing data for important local utilities. Specifically, the region comprising Del Norte, Lassen, Modoc, and Siskiyou Counties is missing Lassen MUD, Pluma/Sierra Co-op, and Surprise Valley Electric Corporation. The region of Colusa, Glenn, Tehama, and Trinity Counties is missing Trinity County Public Utility District. And the region of Nevada, Plumas, and Sierra Counties is missing Lassen MUD and Plumas/Sierra Co-op.
[2] J.K. Boyce and M. Riddle, "Cap and Dividend: How to Curb Global Warming While Protecting the Incomes of American Families," Political Economy Research Institute, November 2007.
[3] Ibid.

For each decile, we calculate the statewide average expenditure increase for electricity, natural gas, and gasoline. We can then work out the per capita dividend required to ensure that the bottom X deciles receive zero or positive net benefits.

We consider two price escalation scenarios:

1. The rates of electricity, natural gas, and gasoline price increases are all 0%. The rationale for considering this scenario is that the cap and dividend policy is only meant to protect consumers against price increases due to the policy, not from the general upward trend in real gasoline prices.

2. The rates of electricity, natural gas, and gasoline price increases follow historical trends. As shown in Figures 4 and 5, nominal electricity prices have increased 2.3%/year in CA and nominal gasoline prices have increased 5.6%/year over the past couple of decades; natural gas prices have increased 6.4%.[4] Subtracting out inflation of 2-3%/year, we assume real rates of increase of 0%/year for electricity, 3%/year for gasoline, and 4%/year for natural gas. Under this scenario, the gasoline price increases from $3.6/gallon to $5.3/gallon in 2020.

Results

Under the 0% price escalation scenario, the optimum fraction of revenue that should be ensure that the bottom X deciles are not made worse off by the policy is nearly independent of the carbon price. To compensate the bottom 3 deciles requires that 33% of revenue be returned as per capita dividends; to compensate the bottom 5 dividends requires that 39% of revenues be returned.

Under the historical price escalation scenario, it is not possible to compensate the average household in any of the deciles for the increase in fuel prices due to the price escalation plus the carbon price.

[4] Energy Information Administration, "California Price of Natural Gas Delivered to Residential Consumers (Dollars per Thousand Cubic Feet)", http://tonto.eia.doe.gov/dnav/pet/hist/n3010ca3a.htm, June 29, 2009.