Distributional Impacts in a Comprehensive Climate Policy Package

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Abstract

This paper provides a simple analytic approach for measuring the burden of carbon pricing that does not require sophisticated and numerically intensive economic models but which is not limited to restricting assumptions of forward shifting of carbon prices. We also show how to adjust for the capital income bias contained in the Consumer Expenditure Survey, a bias towards regressivity in carbon pricing due to overreporting of capital income in lower income deciles in the Survey.

Once one allows for backward shifting, carbon policies look more progressive than when full forward shifting is assumed. Perhaps more important than the findings from any one scenario, our results on the progressivity of the leading cap and trade proposals are robust to the assumptions made on forward and backward shifting of the burden of carbon pricing.

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I. Introduction

Distributional considerations figure importantly in the design of comprehensive climate policy legislation. The allowance allocation in the American Clean Energy and Security Act of 2009 (H.R. 2454), popularly known as the Waxman-Markey bill, that was passed by the House of Representatives in June 2009, suggests the care and attention paid to distributional considerations in crafting the bill. Both the Kerry-Boxer Bill and the Cantwell-Collins proposals in the Senate also paid close attention to distributional considerations.

This paper uses data from the 2003 Consumer Expenditure Survey to allocate the burden of carbon pricing from possible cap and trade legislation under different assumptions about forward and backward shifting of the carbon pricing burden. It builds on previous research using the Consumer Expenditure Survey by generalizing the incidence assumptions beyond the assumption of full forward shifting of the carbon price. It also improves on the measurement of capital income burden allocation by using capital income distribution data from the 2004 Survey of Consumer Finances to augment the data in the Consumer Expenditure Survey.

The approach detailed in this paper provides a method for carrying out a back-of-the-envelope calculation of the distributional impact of carbon pricing using readily available data that allows for sensitivity analysis of assumptions on forward and backward shifting of carbon pricing. We find that allowing for backward shifting of carbon pricing yields less regressive impacts on households looking across the income distribution.

II. Background

Households differ on a number of dimensions that policy makers may care about. When designing a climate policy bill, policy makers have made it clear that many of these dimensions are important and affect the allocation of allowances as well as the mechanisms of allowance use. Households differ by income, regional location, primary heating source and predominant mode of electricity generation among other things. We focus in this paper on measuring the impact of carbon pricing policies on households looking across the income distribution.

In carrying out distributional analyses, a number of considerations come into play. First is the question of how best to sort households to distinguish them by some measure of relative well-being. Income is often used for this ranking and this analysis sorts households by annual income. This brings a potential bias to the analysis to the extent that annual income is a poor proxy for lifetime well-being. As discussed elsewhere (see, for example, Fullerton and Metcalf (2002)) many low-income households are not poor in a lifetime sense. They may have transitorily low income or may be at a low income-earning stage of their careers. In both these cases consumption to income ratios may be unusually high and may provide a misleading picture of the distributional impact of consumption-related taxes (like energy taxes) or carbon pricing policies. Our analysis

below should be interpreted with this in mind. To the extent that we find that carbon pricing is progressive, our measures should be viewed as a lower bound on the progressivity.

A second issue is that the economic impact of carbon pricing depends importantly on how prices adjust to the new equilibrium with carbon pricing. This is particularly important for a policy that creates and distributes financial assets in excess of $100 billion by the middle of this decade (see Congressional Budget Office (2009)). A number of computable general equilibrium economic analyses have argued that carbon pricing will predominantly be passed forward to consumers in the form of higher energy prices. See, for example, Bovenberg and Goulder (2001) and Metcalf et al. (2008).

Based on the assumption of full forward passing of carbon prices into consumer prices, a number of economists have carried out distributional analyses of carbon pricing using the Consumer Expenditure Survey, including Bull, Hassett and Metcalf (1994), Dinan and Rogers (2002), Metcalf (1999), Parry (2004), and Hassett, Mathur and Metcalf (2009). The Consumer Expenditure Survey is particularly useful for this analysis given its high level of detailed disaggregation on household spending patterns. But these analyses are useful only to the degree that the assumption of full forward shifting is correct.

A recent study by Metcalf et al. (2008) found that forward shifting of carbon pricing ranged widely depending on the fuel in question, the proposal under consideration, and the particular year of analysis. Carbon pricing on coal was nearly fully passed forward into higher prices reflecting in large part the low Hotelling resource rents for coal. Shifting for natural gas ranged from a low of 14 percent to a high of over 200 percent. The latter occurs as demand rises for natural gas in the intermediate term as gas substitutes for coal in the production of electricity.[1] Finally forward shifting for crude oil ranged from a low of 2 percent to a high of nearly 90 percent depending on the year and tax scenario.

If taxes are not passed forward to consumers in the form of higher product prices, then they are passed back to factors of production in the form of lower wages, returns to equity, and reduced resource rents. Changes in resource rents can also affect government revenues since much fossil fuel extraction in the United States occurs on publicly owned land (e.g. the Powder River Basin coal reserves in Wyoming and the Outer Continental Shelf oil and gas drilling). We ignore that complication in this analysis in part because the impact of taxes on government revenue from land leasing activities is poorly understood.

This paper uses burden shifting insights from computable general equilibrium models along with the Consumer Expenditure Survey to measure the burden of carbon pricing. A goal of the analysis is to demonstrate the ability to use the survey with a

[1] That natural gas prices may rise by over twice the tax rate indicates the complex price responses that can occur in general equilibrium.

broader range of assumptions to obtain a rough and ready guide to the distributional impacts of carbon pricing proposals without having to run full-blown CGE analyses.

III. Measuring Carbon Price Burdens

Our goal in this paper is to provide a simple rough and ready measure of the burden impact of carbon pricing that builds on the insights of more complex economic analyses. This is in the tradition of a number of studies that use detailed data sets such as the Consumer Expenditure Survey (CEX) along with results and insights from sophisticated economic models to allocate the burden of government policies to different economic groups.

As noted above, previous studies using the CEX have assumed that carbon pricing is fully passed forward into higher consumer prices based on the carbon content of goods and services. Input output tables from the Bureau of Economic Analysis are used to trace through carbon content and thus carbon pricing impacts. If carbon prices are passed back to factors of production, then we need to use income information in the CEX to distribute the carbon pricing impacts. For carbon burdens passed back to owners of capital, we wish to distribute the burden based on each household's ownership share in energy producing industries. Lacking detailed information on ownership patterns in this industry, we assume that ownership shares are the same as overall capital ownership. There are no data in the CEX on capital ownership shares and so we fall back on capital income shares as a proxy for capital ownership shares.

Carbon pricing burdens may also fall on owners of fossil fuel resources. To the extent these resources are privately owned, carbon pricing may lead to a reduction in returns to owning property with fossil fuel resources. Some of this property is held by sole proprietors and partnerships while other tracts are owned by corporations. Lacking detailed information on resource ownership, we assume that resource ownership is distributed across households in the same manner as capital.

Turning to allowances, we can allocate the value of allowances to households either according to consumption or income patterns depending on how allowances are distributed. The Waxman-Markey bill sets aside roughly 30 percent of allowances in the early years for distribution to customers of electricity and natural gas utilities to compensate them for higher electricity and gas prices. We allocate the value of those allowances to households based on their electricity and natural gas expenditures respectively. Allocations to industry are assumed to benefit owners of capital. Allocations to households are distributed to households.

In general we follow the distribution approach of Rausch et al. (2010) for distributing the value of allowances. One place where we differ is in the allocation of allowances to the U.S. government for deficit reduction. Under the assumption that reductions in the deficit reduce pressure to decrease government spending we allocate the allowances for deficit reduction based on government spending that would otherwise

have to be cut. Our assumptions on the benefits of government spending across the income distribution are taken from The Tax Foundation (2007).

Rather than assume a particular burden sharing outcome, we report results for four different scenarios to illustrate the importance of the burden sharing assumption on distributional outcomes. The four scenarios we consider are reported in Table 1.[2] The first scenario assumes full forward shifting of carbon pricing to final consumers. The next three assume increasing amounts of backward shifting with different distributions between labor and capital.

Table 1. Burden Shifting Assumption

Incidence Assumption	Consumers	Capital and Resources	Labor
1	100%	0%	0%
2	80%	20%	0%
3	80%	10%	10%
4	50%	25%	25%

IV. Issues in Using the Consumer Expenditure Survey

The Consumer Expenditure Survey has been used by a number of researchers investigating the burden impacts of carbon pricing because of its rich detail on consumption patterns of U.S. households. It also contains information on the demographic makeup of households as well as some income information. The CEX has a single capital income measure that researchers have used to allocate taxes to owners of capital in scenarios assuming some degree of backward shifting. The survey question for this data asks whether households received any regular income from dividends, trusts, estates, or royalties. A separate question asks about interest income from bank accounts, money market funds, CDs, or bonds. Researchers have used the dividend income amount (or dividends and interest) as a proxy for capital holdings under the assumption that capital income is proportional to capital holdings.

The problem with using CEX reported capital income is that it may misrepresent capital holdings across income groups. There are two possible reasons. First, the CEX focuses primarily on spending and the income data quality may not be as high quality as the spending data. Second, if holdings of growth stocks are disproportionately held by higher income groups then the CEX capital income measure will be biased towards more capital holdings in lower income groups. Table 2 suggests that the first problem is significant with the CEX showing more capital income in the lower income deciles than the SCF.[3]

[2] This approach is in the spirit of the classic distributional analysis by Pechman (1985).

[3] Income cutoffs for the deciles are $10,304, 17,000, 24,000, 32,000, 40,200, 50,655, 65,032, 81,700, and 108,768.

Table 2: Distribution of Capital Income Across Households		
Decile	Consumer Expenditure Survey	Survey of Consumer Finances
1	0.004	0.001
2	0.007	0.005
3	0.007	0.011
4	0.159	0.015
5	0.033	0.019
6	0.027	0.015
7	0.050	0.037
8	0.020	0.027
9	0.156	0.060
10	0.542	0.810
Source: Authors' calculations from 2003 CEX and 2004 SCF		

Using data from the 2004 SCF, Wolfe (2010) estimates that 85 percent of net worth capital is held by households in the top quintile and 92 percent of non-household wealth by this quintile. The CEX in contrast reports only 70 percent of capital income accruing to the top quintile. Using CEX capital income distributions will skew any carbon pricing distribution toward greater progressivity to the extent that any of the burden is placed on owners of capital.

. One advantage of using the SCF is that it disproportionately samples wealthy families. Each survey consists of a core representative sample combined with a high-income supplement, which is drawn from the Internal Revenue Service's Statistics of Income data file. Further, the survey questionnaire consists of detailed questions on different components of family wealth holdings. For these reasons, the SCF is widely acknowledged to be the best at capturing both the wealth at the top of the distribution and the complete wealth portfolio of households in the middle. Since the wealth distribution is highly skewed towards the top, most other surveys (like the CEX) that have poor data on high income families tend to underreport measures of income and wealth.

The problem of distributional bias is not as significant for labor income as for capital income. Table 3 reports labor income shares across deciles from the CEX and SCF. The distributions are more closely aligned than those for capital income.

Table 3: Distribution of Labor Income Across Households		
Decile	Consumer Expenditure Survey	Survey of Consumer Finances
1	0.003	0.003
2	0.012	0.011
3	0.025	0.023
4	0.042	0.039
5	0.063	0.054
6	0.083	0.073
7	0.114	0.088
8	0.143	0.126
9	0.185	0.178
10	0.331	0.403
Source: Authors' calculations from 2003 CEX and 2004 SCF		

In this analysis we distribute the burden of carbon pricing that is shifted to owners of capital based on the distribution of capital income from the SCF (Table 2 above).

V. Results

The distributional tables below are based on a carbon pricing policy that yields a carbon price of $15 per ton CO_2. This is consistent with permit price estimates in the 2015 to 2020 period for either H.R. 2454 (Waxman-Markey) or the Kerry-Boxer Bill in the Senate. In the analyses in which allowance revenues are returned to households, we assume full return of revenue to households allocating permit value using the assumptions in Rausch, et al. (2010).

Table 4 shows results for a cap and trade program in which we ignore the rebate of permit revenue to households. This scenario focuses on carbon pricing itself without the confounding effects of allowance allocations.

The first scenario assumes carbon pricing is fully reflected in higher consumer prices. Carbon pricing is regressive in this scenario with the burden of higher consumer prices falling from 3.7 percent of household income in the lowest income decile to 0.8 percent of household income for the top decile.[4] The ratio of burdens between the top and bottom deciles is 4.6. If twenty percent of the burden of carbon pricing is shifted back to owners of capital and resources, the regressivity of carbon pricing is blunted somewhat with the ratio of burdens between the top and bottom deciles falling to 2.3. Shifting part of the burden from capital to labor (scenario 3) increases the regressivity slightly relative to scenario 2. Scenario 4 shows that the regressivity of carbon pricing is blunted as more of the burden is shifted back to factors of production – with the burden

[4] The incidence numbers look marginally different from those in Hasset, Mathur and Metcalf (2009) since we are not accounting for the differential impact on electricity prices across regions in this study.

shifting to capital the most important. In this case the burden share in the lowest decile is only 20 percent higher than the burden in the top decile.

Table 4: Incidence of Carbon Pricing Across Households: No Rebate

	Incidence Assumption			
Decile	1	2	3	4
1	3.70	2.99	3.02	2.01
2	3.05	2.48	2.51	1.71
3	2.31	1.93	1.97	1.46
4	2.03	1.71	1.76	1.36
5	1.75	1.47	1.54	1.23
6	1.51	1.26	1.35	1.09
7	1.30	1.13	1.20	1.03
8	1.24	1.04	1.14	0.98
9	1.02	0.91	0.99	0.96
10	0.82	1.29	1.15	1.64

Source: Authors' calculations. Table reports burden as a percentage of household income.

Table 4 considers the burden of carbon pricing with no consideration as to the distribution of carbon revenues. Considerable effort has been taken in the various cap and trade proposals in the House and Senate to allocate allowances (or allowance value) to offset the price impacts of carbon pricing. We turn now to a comparison of distributional results for the various burden shifting scenarios identified in Table 1. The allocation of allowances is based on the analysis of proposed cap and trade legislation carried out by Rausch, et al. (2010). As these authors stress, the analysis only focuses on the allowance allocations in the bill and ignores all other aspects of the legislation. Thus one should not view these distributions as representative of the actual distributions that will result from enactment of any of these bills.[5]

Table 5 reports results for the Waxman-Markey allowance allocation approach. The bill has a complex allocation schedule for each of the years between 2012 and 2050. For this and the other two proposals we analyze we consider the distributions in 2020 and 2050.

[5] Rausch, et al. (2010) note other differences – in particular the ability to use domestic and international offsets in the various proposals. Those considerations are not relevant for our analysis.

Table 5: Distribution for Waxman-Markey Scenarios								
	Incidence Assumptions: 2020				Incidence Assumptions: 2050			
Decile	1	2	3	4	1	2	3	4
1	-2.38	-3.09	-3.06	-4.07	-5.38	-6.10	-6.06	-7.08
2	-1.27	-1.84	-1.80	-2.60	-2.68	-3.25	-3.21	-4.02
3	-0.62	-1.00	-0.96	-1.47	-1.47	-1.84	-1.81	-2.32
4	-0.98	-1.31	-1.26	-1.66	-0.67	-0.99	-0.94	-1.34
5	0.56	0.29	0.35	0.04	0.31	0.04	0.10	-0.21
6	0.54	0.29	0.37	0.12	0.35	0.10	0.19	-0.07
7	0.43	0.26	0.32	0.16	0.39	0.22	0.28	0.12
8	0.56	0.36	0.46	0.30	0.50	0.30	0.40	0.24
9	0.23	0.11	0.20	0.16	0.42	0.30	0.39	0.35
10	-0.02	0.46	0.31	0.81	0.42	0.90	0.75	1.24

The first thing to note in Table 5 is that the carbon pricing reform (taking into account the burden of carbon pricing and the distribution of allowance value) is progressive regardless of the assumptions made about burden sharing between consumers and factors of production. Assuming full forward shifting of the carbon price (incidence assumption 1) the burden of carbon pricing with allowance allocation in 2020 falls from -2.4 percent of household income for the lowest decile to -0.02 percent for the top decile. The bottom 40 percent of the income distribution get back more in allowance revenue (either directly or indirectly through allocations that reduce product prices for them) than they pay in higher prices of goods and services because of carbon pricing. Assuming full forward shifting, the progressivity is even higher in 2050.

Assuming 20 percent of the burden is shifted from consumers to owners of capital and resources, the progressivity increases in both 2020 and 2050. The highest degree of progressivity occurs under incidence assumption 4 where half the burden is shifted back to factors of production with labor and capital equally sharing the burden. To draw parallels, it is interesting to note that the carbon pricing burden with the rebate is marginally less than half the value of the Earned Income Tax Credit subsidy for the bottom decile. The share of the EITC in total adjusted gross income for the bottom decile was approximately 18 percent in 2007.[6]

Based on the results from recent CGE analyses, incidence assumption 2 should probably be viewed as the most reasonable of the four assumptions. Taking this as the base case scenario, analyses that assume full forward shifting of carbon pricing bias results towards greater regressivity than is in fact the case.

Table 6 presents results for the Kerry-Boxer allowance allocation scheme. Results are very similar to those for Waxman-Markey. Results for the Cantwell-Collins allowance allocation are quite different from either Waxman-Markey or Kerry-Boxer due

[6] http://www.irs.gov/taxstats/indtaxstats/article/0,,id=133414,00.html

to a very different approach to allocation taken by this proposal (Table 7). Whereas the former two proposals have a complex allocation scheme distributing allowances to industry and to gas and electricity local distribution companies, Cantwell-Collins rebates three-quarters of the allowance revenue to households on an equal per capita basis. The remaining allowance revenue is used for various clean energy investments and regional programs.

Table 6: Distribution for Kerry-Boxer Scenarios								
	Incidence Assumptions: 2020				Incidence Assumptions: 2050			
Decile	1	2	3	4	1	2	3	4
1	-2.86	-3.58	-3.54	-4.56	-6.05	-6.77	-6.73	-7.75
2	-1.50	-2.07	-2.04	-2.84	-3.08	-3.65	-3.62	-4.42
3	-0.67	-1.05	-1.01	-1.52	-1.51	-1.88	-1.85	-2.36
4	-0.92	-1.25	-1.19	-1.60	-0.72	-1.05	-0.99	-1.40
5	0.49	0.21	0.28	-0.03	0.28	0.01	0.07	-0.24
6	0.49	0.23	0.32	0.07	0.33	0.08	0.17	-0.09
7	0.41	0.24	0.30	0.14	0.39	0.22	0.29	0.12
8	0.54	0.34	0.44	0.28	0.51	0.31	0.41	0.25
9	0.23	0.12	0.20	0.17	0.39	0.28	0.37	0.33
10	0.03	0.50	0.36	0.85	0.40	0.88	0.73	1.22

The Cantwell-Collins distribution is markedly more progressive than the previous programs. This follows primarily from the largely lump-sum nature of rebate approach taken in this bill. Assuming some of the tax is passed back to owners of capital and energy resources increases the progressivity of the program relative to the assumption of full forward shifting.

Table 7: Distribution for Cantwell-Collins Scenarios								
	Incidence Assumptions: 2020				Incidence Assumptions: 2050			
Decile	1	2	3	4	1	2	3	4
1	-3.36	-4.07	-4.04	-5.05	-3.69	-4.40	-4.37	-5.38
2	-1.42	-1.99	-1.96	-2.76	-1.59	-2.16	-2.13	-2.93
3	-0.68	-1.05	-1.02	-1.52	-0.72	-1.10	-1.06	-1.57
4	-0.21	-0.54	-0.48	-0.88	-0.22	-0.55	-0.49	-0.90
5	0.01	-0.26	-0.19	-0.51	0.03	-0.25	-0.18	-0.49
6	0.12	-0.14	-0.05	-0.30	0.14	-0.12	-0.03	-0.28
7	0.20	0.03	0.10	-0.07	0.23	0.06	0.12	-0.04
8	0.36	0.16	0.25	0.09	0.38	0.18	0.28	0.12
9	0.31	0.20	0.28	0.25	0.33	0.22	0.30	0.26
10	0.36	0.83	0.69	1.18	0.37	0.85	0.70	1.20

VI. Conclusion

Carbon pricing is regressive though the extent of the regressivity depends on the degree of backward shifting of the carbon price. Once one allows for a distribution of some or all of the value of the allowances back to households – either directly or indirectly through grants to industry – the policy now looks progressive.[7] This is true for any of the three leading cap and trade proposals currently under consideration by Congress.

This paper provides a simple analytic approach for measuring the burden of carbon pricing that does not require sophisticated and numerically intensive economic models but which is not limited to restricting assumptions of forward shifting of carbon prices. We also show how to adjust for the capital income bias contained in the Consumer Expenditure Survey, a bias towards regressivity in carbon pricing due to overreporting of capital income in lower income deciles in the CEX.

Once one allows for backward shifting, carbon policies look more progressive than when full forward shifting is assumed. Perhaps more important than the findings from any one scenario, our results on the progressivity of the leading cap and trade proposals are robust to the assumptions made on forward and backward shifting of the burden of carbon pricing.

[7] This highlights the distinction between a green tax and a green tax reform made by Metcalf (1999).

References

Bovenberg, A. Lans and Goulder, Laurence. "Neutralizing the Adverse Industry Impacts of CO2 Abatement Policies: What Does It Cost?," C. Carraro and G. E. Metcalf, *Distributional and Behavioral Effects of Environmental Policy.* Chicago: University of Chicago Press, 2001, 45-85.

Bull, Nicholas; Hassett, Kevin A. and Metcalf, Gilbert E. "Who Pays Broad-Based Energy Taxes? Computing Lifetime and Regional Incidence." *Energy Journal*, 1994, *15*(3), pp. 145-64.

Congressional Budget Office. "H.R. 2454 American Clean Energy and Security Act of 2009 Cost Estimate." Congressional Budget Office, 2009.

Dinan, Terry and Rogers, Diane Lim. "Distributional Effects of Carbon Allowance Trading: How Government Decisions Determine Winners and Losers." *National Tax Journal*, 2002, *55*(2), pp. 199-221.

Fullerton, Don and Metcalf, Gilbert E. "Tax Incidence," A. J. Auerbach and M. Feldstein, *Handbook of Public Economics.* Amsterdam: Elsevier Science, 2002, 1787-872.

Hassett, Kevin A.; Mathur, Aparna and Metcalf, Gilbert E. "The Incidence of a U.S. Carbon Tax: A Lifetime and Regional Analysis." *The Energy Journal*, 2009, *30*(2), pp. 157-79.

Metcalf, Gilbert E. "A Distributional Analysis of Green Tax Reforms." *National Tax Journal*, 1999, *52*(4), pp. 655-81.

Metcalf, Gilbert E.; Paltsev, Sergey; Reilly, John M.; Jacoby, Henry D. and Holak, Jennifer. "Analysis of a Carbon Tax to Reduce U.S. Greenhouse Gas Emissions." MIT Joint Program on the Science and Policy of Global Change Report No. 160, 2008.

Parry, Ian W. H. "Are Emissions Permits Regressive." *Journal of Environmental Economics and Management*, 2004, *47*, pp. 364-87.

Pechman, J. *Who Paid the Taxes: 1966-85?* Washington DC: Brookings, 1985.

Rausch, Sebastian; Metcalf, Gilbert E.; Reilly, John M. and Paltsev, Sergey. "Distributional Implications of Proposed U.S. Greenhouse Gas Control Measures." Joint Program on the Science and Policy of Global Change mimeo, 2010.

The Tax Foundation. "Who Pays America's Tax Burden, and Who Gets the Most Government Spending?" The Tax Foundation Special Report No. 151, 2007.

Wolfe, Edward N. "Recent Trends in Household Wealth in the United States: Rising Debt and the Middle-Class Squeeze—an Update to 2007." Levy Economics Institute Working Paper No. 589, 2010.